DEPARTMENT OF RUBBER AND PLASTICS TECHNOLOGY
ANNA UNIVERSITY :: MIT CAMPUS

Vision

The Department of Rubber and Plastics Technology shall constantly strive to be renowned for its academic and research excellence with professionalism and social responsibilities

Mission

The Mission of the Department of Rubber and Plastics Technology is to:

- Equip its graduates to meet the expectations of Rubber, Plastics and allied industries and professional organizations
- Expand its knowledge base in collaboration with Rubber, Plastics and allied industries and research organizations
- Emphasize on product design aspects so as to enable graduates to be innovators in the field of Rubber, Plastics and allied areas of Technology
- Motivate students to become entrepreneurs
- Carry out inter-disciplinary research and development activities integrating Rubber and Plastics Technology with other Engineering disciplines

ANNA UNIVERSITY::CHENNAI - 600 025

UNIVERSITY DEPARTMENTS

B.TECH. RUBBER AND PLASTICS TECHNOLOGY

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM (CBCS)

1.PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Graduates of the programme, with the acquired knowledge and skills in Rubber, Plastics and allied domains, will provide quality services to Rubber and Plastics industries and professional organizations

PEO 2: Graduates of the programme will be in the forefront of innovation, updating new knowledge through continuous learning, research and developmental activities

PEO 3: Graduates of the programme, by keeping pace with changing technological developments, will provide leadership to industry and research organizations

2.PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

2**. Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3.PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1 With the understanding of fundamental principles of polymers and working mechanisms,graduates will be able to design and develop rubber, plastics and composites products

PSO 2 Graduates will be able to employ modern characterization techniques, design and analysis software for predicting the behavior of polymer systems in engineering and technology

PSO 3 Graduates will able to choose materials, design processes and products for environmental sustainability

PSO 4 With sound industry experience, graduates will strive to be entrepreneurs

4. MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVE WITH PROGRAMME OUTCOMES

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	**3**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**1**
2	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**3**
3	**1**	**1**	**2**	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**2**

5. MAPPINGOF COURSEOUTCOME, PROGRAMME OUTCOME AND PROGRAMME SPECIFIC OUTCOME

YEAR	SEM	Course Title	Programme Outcomes												Programme Specific Outcomes			
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
I	SEMESTER I	Technical English						3	3	3	3	3		3				
		Engineering Mathematics I	3	3	3	2	2							2				
		Engineering Physics	3	3	3	2	2											
		Engineering Chemistry	3	3	3	2	2											
		Engineering Graphics	3	3	3	3	3	3			1		2	3				
		Basic Sciences Lab	3	3	3	3	3											
		Workshop Practices Lab	3	3	3	3	3				2		1					
	SEMESTER II	Professional Communication						1	1		3	3		3				
		Engineering Mathematics II	3	3	3	3	3				1			3				
		Basics of Electrical and Electronics Engineering	3	2	2	1	1					1		1				
		Problem Solving and Python Programming	3	3	3	3	3						3	3				
		Engineering Mechanics	3	3	3	2	3				1		1					
		Materials Science	2	1					1		1	2		1				
		Problem Solving and Python Programming Laboratory	3	3	3	3	3						3	3				
		Electrical and Electronics Engineering Lab	2.6	2.6	2.6		2.6				2	2		1				

II	SEMESTER III	Probability and Statistics																
		Elective - Humanities I																
		Mechanics of solid	3	3	3	3		2	2									
		Introduction To Polymer Science	3	3	3	3		3	3					2	3		3	3
		Thermodynamics and Thermal Engineering	3	3	3	3	3	1	1		2	2		3				
		Fluid Mechanics and Fluid Machines	2.4	2.2	1	2	1.6	1.2	1.2	1.4	1.4	1	1.2	1				
		Polymer Science Lab	3	3	3	3	1	3	3	2	3	3	3	3	3	2	2	3
		Mechanical Sciences Laboratory	3	2	2	2	1	2	2	1	3	2		2				
	SEMESTER IV	Principles of Management	2.6				2.5	2.4	2	2	2.2	3	3	2.2				
		Environmental Sciences																
		Audit Course - I																
		Physical Properties Of Polymers	3	3	3	3	2		2		2	1	2	2	3	2	2	1
		Introduction To Chemical Engineering	3	2	3	2	3	3	2	3	2	3	2	1	3	3	1	3
		Rubber Materials	3	1	1			1	1					1	3		2	3
		Plastics Materials	3	3	3	3		3	3					2	3		3	3
		Cad Practice Lab	3	3	3	3	3	1		1	1	1	1	1	3	1		1
		Rubber Materials Laboratory	3	3	2	3	2	1	2		2	3	1	2	3	2	2	2

III	SEMESTER V	Electives - Humanities I																
		Rubber Compounding	3	3	3	2	2	2	1				3	3		3	3	3
		Rubber Processing And Product Manufacture	3	3	3	2	2	2	1				3	3	3	3	3	3
		Polymer Composite Materials	3	3	3	2	2	2					3	3	3		3	3
		Plastics Processing And Machinery	3	2	3	2	3	2	2	2	2	3	2	3	3	2	2	3
		Professional Elective - I																
		Professional Elective - II																
		Rubber Processing Lab	1	3	3	3	2	2	1				1	2	2	1	1	1
		Rubber And Plastics Laboratory	3	2	3	3	3		2	1	2	2		2	2	3	2	2
	SEMESTER VI	Plastics Product Design		3	3	3	3	2						3	3	1	3	3
		Rubber Product Design		3	3	3	3	2						3	3	1	3	3
		Composites Technology	3	3	3	3		3	3	2	2			2	3	2	3	3
		Professional Elective - III																
		Professional Elective - IV																
		Open Elective - I																
		Product And Mould Design Laboratory	3	3	2	3	3								3	3		1
		Plastics Processing lab			3	3	3	2	2						2	2	3	3

IV	SEMESTER VII	Technology Of Tyres And Tubes		3	3	3	3	2	2					3	3	3	3	3
		Audit Course - II																	
		Professional Elective - V																	
		Professional Elective - VI																	
		Open Elective - II																	
		Comprehension	3	3	3							3		3	3	3	3		
		Project I	1	3	3	2	3	2	3	2	3	2	2	3	3	3	3	2	
	SEMESTER VIII	Project II	1	3	3	2	3	2	3	2	3	2	2	3	3	3	3	2.2	
		Internship/Training		3	3	1	3	2	3	2	3	2	2	3	3	3	3	2	

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

B.TECH. RUBBER AND PLASTICS TECHNOLOGY

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

CURRICULUMAND SYLLABI FOR I TO VIII SEMESTERS

SEMESTER I

SI. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT HRS	CREDITS
				L	T	P		
THEORY								
1.	HS5151	Technical English	HSMC	3	0	0	3	3
2.	MA5158	Engineering Mathematics I	BSC	3	1	0	4	4
3.	PH5151	Engineering Physics	BSC	3	0	0	3	3
4.	CY5151	Engineering Chemistry	BSC	3	0	0	3	3
5.	GE5151	Engineering Graphics	ESC	1	0	4	5	3
6.	GE5154	தமிழர் மரபு /Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICALS								
7.	BS5161	Basic Sciences Lab	BSC	0	0	4	4	2
8.	GE5162	Workshop Practices Lab	ESC	0	0	4	4	2
9.	GE5163	English Laboratory[$]	EEC	0	0	2	2	1
			TOTAL	**14**	**1**	**14**	**29**	**22**

SEMESTER II

Sl. NO.	CODE NO.	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT HRS	CREDITS
				L	T	P		
THEORY								
1.	HS5251	Professional Communication	HSMC	2	0	0	2	2
2.	MA5252	Engineering Mathematics II	BSC	3	1	0	4	4
3.	GE5153	Problem Solving and Python Programming	ESC	3	0	0	3	3
4.	EE5251	Basics of Electrical and Electronics Engineering	ESC	3	0	0	3	3
5.	GE5152	Engineering Mechanics	ESC	3	1	0	4	4
6.	PH5251	Materials Science	BSC	3	0	0	3	3
7.	GE5252	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	0	0	1	1
PRACTICALS								
8.	GE5161	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
9.	EE5261	Electrical &Electronics Engineering Lab	ESC	0	0	4	4	2
10.	GE5262	Communication Laboratory / Foreign Language	EEC	0	0	4	4	2
			TOTAL	**18**	**2**	**12**	**32**	**26**

SEMESTER III

Sl. No.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT HRS	CREDITS
				L	T	P		
THEORY								
1.	MA5354	Probability and statistics	BSC	3	1	0	4	4
2.		Elective - Humanities I	HSMC	3	0	0	3	3
3.	AU5352	Mechanics of solids	ESC	3	0	0	3	3
4.	RP5301	Introduction to Polymer Science	PCC	3	0	0	3	3
5.	AU5351	Thermodynamics and Thermal engineering	ESC	3	1	0	4	4
6.	AE5351	Fluid Mechanics and Fluid Machines	ESC	3	0	0	3	3
PRACTICALS								
7.	RP5311	Polymer Science lab	PCC	0	0	4	4	2
8.	AU5361	Mechanical Sciences Laboratory	ESC	0	0	4	4	2
9.	GE5361	Professional Development[$]	EEC	0	0	2	2	1
			TOTAL	**18**	**2**	**8**	**28**	**24**

[$] **Skill Based Course**

SEMESTER IV

SI. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT HRS	CREDITS
				L	T	P		
THEORY								
1.	MG5451	Principles of Management	HSMC	3	0	0	3	3
2.	GE5251	Environmental Sciences	BSC	3	0	0	3	3
3.		Audit Course - I*	AC	3	0	0	3	0
4.	RP5401	Physical Properties of Polymers	PCC	3	0	0	3	3
5.	RP5402	Introduction to Chemical Engineering	PCC	3	0	0	3	3
6.	RP5403	Rubber Materials	PCC	3	0	0	3	3
7.	RP5404	Plastics Materials	PCC	4	0	0	4	4
PRACTICALS								
8.	RP5411	CAD Practice Lab	PCC	1	0	3	4	2
9.	RP5412	Rubber Materials Lab	PCC	0	0	4	4	2
			TOTAL	**23**	**0**	**7**	**30**	**23**

***** Audit Courseis optional.

SEMESTER V

SI. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT HRS	CREDITS
				L	T	P		
THEORY								
1.		Elective -Humanities I	HSMC	3	0	0	3	3
2.	RP5501	Rubber Compounding	PCC	3	0	0	3	3
3.	RP5502	Rubber Processing and Product Manufacture	PCC	3	0	0	3	3
4.	RP5503	Polymer Composite Materials	PCC	3	0	0	3	3
5.	RP5504	Plastics Processing and Machinery	PCC	3	0	0	3	3
6.		Professional Elective - I	PEC	3	0	0	3	3
7.		Professional Elective - II	PEC	3	0	0	3	3
PRACTICALS								
8.	RP5511	Rubber Processing lab	PCC	0	0	4	4	2
9.	RP5512	Rubber and Plastics testing lab	PCC	0	0	4	4	2
			TOTAL	**21**	**0**	**8**	**29**	**25**

SEMESTER VI

SI. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT HRS	CREDITS
				L	T	P		
THEORY								
1.	RP5601	Plastics Product Design	PCC	3	0	0	3	3
2.	RP5602	Rubber Product Design	PCC	3	0	0	3	3
3.	RP5603	Composites Technology	PCC	2	0	2	4	3
4.		Professional Elective - III	PEC	3	0	0	3	3
5.		Professional Elective - IV	PEC	3	0	0	3	3
6.		Open Elective - I	OEC	3	0	0	3	3
PRACTICALS								
7.	RP5611	Product and Mould Design Lab	PCC	0	0	4	4	2
8.	RP5612	Plastics Processing lab	PCC	0	0	4	4	2
	RP5811	Internship/ Training**	EEC	-	-	-	-	-
			TOTAL	**17**	**0**	**10**	**27**	**22**

****** Students shall undergo Internship/ Trainingfor a minimum period of 4 weeks and assessment of the same will be doneduring sixth and seventh semester

SEMESTER VII

SI. NO.	CODE NO.	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT HRS	CREDITS
				L	T	P		
THEORY								
1.	RP5701	Technology of Tyres and Tubes	PCC	3	0	0	3	3
2.		Audit Course - II*	AC	3	0	0	3	0
3.		Professional Elective - V	PEC	3	0	0	3	3
4.		Professional Elective - VI	PEC	3	0	0	3	3
5.		Professional Elective - VII	PEC	3	0	0	3	3
6.		Open Elective - II	PEC	3	0	0	3	3
PRACTICALS								
6.	RP5711	Comprehension	PCC	0	0	4	4	2
7.	RP5712	Project I	EEC	0	0	6	6	3
8.	RP5811	Internship/ Training**	EEC	-	-	-	-	-
			TOTAL	**18**	**0**	**10**	**28**	**20**

***** Audit Courseis optional.

******Students shall undergo Internship/ Trainingfor a minimum period of 4 weeks and assessment of the same will be doneduring seventh and eight semester

SEMESTER VIII

Sl. NO.	CODE NO.	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT HRS	CREDITS
				L	T	P		
1	RP5811	Internship/ Training**	EEC	-	-	-	-	2
2	RP5812	Project II	EEC	0	0	16	16	8
			TOTAL	**0**	**0**	**16**	**16**	**10**

TOTAL CREDITS: 173

HUMANITIES AND SOCIAL SCIENCES (HSMC) – MANAGEMENT AND OTHERS

SL. NO.	CODE NO.	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1	HS5151	Technical English	4	0	0	4	I
2	GE5154	தமிழர் மரபு /Heritage of Tamils	1	0	0	1	1
3	GE5252	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	1	0	0	1	1
4	HS5251	Professional Communication	4	0	0	4	II
5	MG5451	Principles of Management	3	0	0	3	IV
					Total Credits	**11**	

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5171	Language and Communication	3	0	0	3
2.	HU5172	Values and Ethics	3	0	0	3
3.	HU5173	Human Relations at Work	3	0	0	3
4.	HU5174	Psychological Process	3	0	0	3
5.	HU5175	Education, Technology and Society	3	0	0	3
6.	HU5176	Philosophy	3	0	0	3
7.	HU5177	Applications of Psychology in Everyday Life	3	0	0	3

LIST OF BASIC SCIENCE COURSES (BSC)

Sl. NO.	CODE. NO	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1	MA5158	Engineering Mathematics I	3	1	0	4	I
2	PH5151	Engineering Physics	3	0	0	3	I
3	CY5151	Engineering Chemistry	3	0	0	3	I
4	BS5161	Basic Sciences Lab	0	0	4	2	I
5	MA5252	Engineering Mathematics II	3	1	0	4	II
6	PH5251	Materials Science	3	0	0	3	II
7	MA5354	Probability and Statistics	3	1	0	4	III
8	GE5251	Environmental Sciences	3	0	0	3	IV
		Total Credits				**26**	

LIST OF ENGINEERING SCIENCE COURSES (ESC)

Sl. No.	CODE NO.	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1	GE5151	Engineering Graphics	1	0	4	3	I
2	GE5162	Workshop Practices Lab	0	0	4	2	I
3	GE5153	Problem Solving and Python Programming	3	0	0	3	II
4	EE5251	Basics of Electrical and Electronics Engineering	3	0	0	3	II
5	GE5152	Engineering Mechanics	3	1	4	4	II
6	GE5161	Problem Solving and Python Programming Laboratory	0	0	4	2	II
7	EE5261	Electrical &Electronics Engg Lab	0	0	4	2	II
8	AU5352	Mechanics of solids	3	0	0	3	III
9	AU5351	Thermodynamics and Thermal Engineering	3	1	0	4	III
10	AE5351	Fluid Mechanics and Fluid Machines	3	0	0	3	III
11.	AU5361	Mechanical Sciences Lab	0	0	4	2	III
		Total Credits				**31**	

LIST OF PROFESSIONAL CORE COURSES (PCC)

SI. NO.	CODE. NO.	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	RP5301	Introduction to Polymer Science	3	0	0	3	III
2.	RP5311	Polymer Science lab	0	0	4	2	III
3.	RP5401	Physical Properties of Polymers	3	0	0	3	IV
4.	RP5402	Introduction to Chemical Engineering	3	0	0	3	IV
5.	RP5403	Rubber Materials	3	0	0	3	IV
6.	RP5404	Plastics Materials	4	0	0	4	IV
7.	RP5411	CAD Practice Lab	1	0	3	2	IV
8.	RP5412	Rubber Materials Lab	0	0	4	2	IV
9.	RP5501	Rubber Compounding	3	0	0	3	V
10.	RP5502	Rubber Processing and Manufacture	3	0	0	3	V
11.	RP5503	Polymer Composite Materials	3	0	0	3	V
12.	RP5504	Plastics Processing and Machinery	3	0	0	3	V
13.	RP5511	Rubber Processing lab	0	0	4	2	V
14.	RP5512	Rubber and Plastics Testing lab	0	0	4	2	V
15.	RP5601	Plastics Product Design	3	0	0	3	VI
16.	RP5602	Rubber Product Design	3	0	0	3	VI
17.	RP5603	Composites Technology	2	0	2	3	VI
18.	RP5611	Product and Mould Design Lab	0	0	4	2	VI
19.	RP5612	Plastics Processing lab	0	0	4	2	VI
20.	RP5701	Technology of Tyres and Tubes	3	0	0	3	VII
21.	RP5711	Comprehension	0	0	4	2	VII
		Total Credits				**56**	

LIST OF PROFESSIONAL ELECTIVES COURSES (PEC)

SI. NO.	CODE. NO	COURSETITLE	L	T	P	C
1	MA5353	Numerical Methods	3	1	0	4
2	LT5071	Entrepreneurship Development	3	0	0	3
3	GE5074	Fundamentals of Nanoscience	3	0	0	3
4	GE5451	Total Quality Management	3	0	0	3
5	GE5552	Engineering Management	3	0	0	3
6	GE5551	Statistics for Production Management	3	0	0	3
7	RP5001	Adhesives and Paints	3	0	0	3
8	RP5002	Advanced Plastics Processing	3	0	0	3
9	RP5003	Biopolymers and Polymers from Renewable Resources	3	0	0	3
10	RP5004	Design of Machine Elements	3	0	0	3
11	RP5005	Engineering and High Performance Plastics	3	0	0	3
12	RP5006	Finite Element Analysis for Polymers	3	0	0	3
13	RP5007	Fracture and Failure in Polymers	3	0	0	3
14	RP5008	Latex Science and Technology	3	0	0	3
15	RP5009	Mould Engineering and Manufacture	3	0	0	3
16	RP5010	Polymers in Packaging Technology	3	0	0	3
17	RP5011	Polymer Recycling	3	0	0	3
18	RP5012	Polyurethane Science and Technology	3	0	0	3
19	RP5013	Product Development and Cost Estimation	3	0	0	3
20	RP5014	Rubber and Plastics Testing	3	0	0	3
21	RP5015	Rubber Components in Automobiles	3	0	0	3
22	RP5016	Technology of Polymer Blends	3	0	0	3
23	RP5017	Theoryof Machinesand Mechanisms	3	0	0	3
24	RP5018	Polymer Characterization Techniques	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Code No.	Course Title	Periods per week			Credits	Semester
			L	T	P		
1	GE5163	English Laboratory[$]	0	0	2	1	I
2	GE5262	Communication Laboratory / Foreign Language[$]	0	0	4	2	II
3	GE5361	Professional Development[$]	0	0	2	1	III
4	RP5811	Internship/ Training	-	-	-	2	VIII
5	RP5712	Project I	0	0	6	3	VII
6	RP5812	Project II	0	0	16	8	VIII
		Total Credits				**13**	

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

Sl. No.	Course Code	Course Title	Periods per week			Credits	Semester
			Lecture	Tutorial	Practical		
1.	AD5091	Constitution of India	3	0	0	0	**2/6**
2.	AD5092	Value Education	3	0	0	0	
3.	AD5093	Pedagogy Studies	3	0	0	0	
4.	AD5094	Stress Management by Yoga	3	0	0	0	
5.	AD5095	Personality Development Through Life Enlightenment Skills	3	0	0	0	
6.	AD5096	Unnat Bharat Abhiyan	3	0	0	0	
7.	AD5097	Essence of Indian Knowledge Tradition	3	0	0	0	
8.	AD5098	Sanga Tamil Literature Appreciation	3	0	0	0	

SUMMARY

CATEGORY	I	II	III	IV	V	VI	VII	VIII	Total credits
HSMC	4	4	3	3	3				16
BSC	12	7	4	3					26
ESC	5	14	12						31
PCC			5	17	16	13	5		56
PEC					6	6	9		21
OEC						3	3		06
EEC							3	10	17
AC (NonCredit)									
Total	22	26	25	23	25	22	20	**10**	**173**

SYLLABI

HS5151	TECHNICAL ENGLISH	L	T	P	C
		4	0	0	4

OBJECTIVES:

The first semester English course entitled 'Technical English' aims to,

- Familiarise first year students of engineering and technology with the fundamental aspects of technical English.
- Develop all the four language skills by giving sufficient practice in the use of the skills in real life contexts.
- Enhance the linguistic and communicative competence of first year engineering and technology students.

UNIT I INTRODUCING ONESELF 12

Listening: Listening and filling a form, listening to speeches by specialists from various branches of engineering and completing activities such as answering questions, identifying the main ideas of the listening text, style of the speaker (tone and tenor) – **Speaking**: Introducing oneself –introducing friend/ family - **Reading:** Descriptive passages (from newspapers / magazines)- **Writing**: Writing a paragraph (native place, school life)- **Grammar:** Simple present, present continuous – **Vocabulary Development**: One word substitution

UNIT II DIALOGUE WRITING 12

Listening: Listening to conversations (asking for and giving directions) –**Speaking:** making conversation using (asking for directions, making an enquiry), Role plays-dialogues- **Reading:** Reading a print interview and answering comprehension questions-**Writing**: Writing a checklist, Dialogue writing- **Grammar**: Simple past – question formation (Wh- questions, Yes or No questions, Tag questions)-**VocabularyDevelopment**: Stress shift, lexical items related to the theme of the given unit.

UNIT III FORMAL LETTER WRITING 12

Listening: Listening to speeches by famous people and identifying the central message of the speech – answering multiple-choice questions)-**Speaking:** Giving short talks on a given topic- **Reading:** Reading motivational essays on famous engineers and technologists (answering open-ended and closed questions)-**Writing:** Writing formal letters/ emails (Complaint letters)-**Grammar**: Future Tense forms of verbs, subject and verb agreement-**Vocabulary Development**: Collocations – Fixed expressions

UNIT IV WRITING COMPLAINT LETTERS 12

Listening: Listening to short talks (5 minutes duration and fill a table, gap-filling exercise) note taking/note making- **Speaking:** Small group discussion, giving recommendations-**Reading:** Reading problem – solution articles/essays drawn from various sources- **Writing:** Making recommendations – Writing a letter/ sending an email to the Editor- note making- **Grammar:** Modals – Phrasal verbs – cause and effect sentences- **Vocabulary Development**: Connectives, use of cohesive devices in writing, technical vocabulary.

UNIT V WRITING DEFINITIONS AND PRODUCT DESCRIPTION 12

Listening: Listening to a product description (labeling and gap filling) exercises- **Speaking:** Describing a product and comparing and contrasting it with other products- **Reading**: Reading graphical material for comparison (advertisements)-**Writing:** Writing Definitions (short and long) – compare and contrast paragraphs- **Grammar:** Adjectives – Degrees of comparison - compound nouns- **Vocabulary Development**: Use of discourse markers – suffixes (adjectival endings).

TOTAL :60 PERIODS

Learning Outcomes

At the end of the course the students will have gained,

- Exposure to basic aspects of technical English.
- The confidence to communicate effectively I various academic situations.
- Learnt the use of basic features of Technical English.

Textbook:

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.

Assessment Pattern

- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1						3	3	3	3	3		3				
CO2						3	3	3	3	3		3				
CO3						3	3	3	3	3		3				
CO4						3	3	3	3	3		3				
CO5						3	3	3	3	3		3				
Overall CO						3	3	3	3	3		3				

MA5158	ENGINEERING MATHEMATICS – I (Common to all branches of B.E. / B.Tech. Programmes in I Semester)	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES **12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS **12**

Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – types of discontinuities – Intermediate Value Theorem – Derivatives of a function - Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – Maxima and minima – Mean value theorem – (Optional: Polar coordinate system – Differentiation in polar coordinates).

UNIT III FUNCTIONS OF SEVERAL VARIABLES **12**

Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS **12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

12

UNIT V MULTIPLE INTEGRALS

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL :60 PERIODS

OUTCOMES:

At the end of the course the students will be able to

- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools n solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXTBOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, New Delhi, 2017.
2. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, 6th Edition, New Delhi,2013.
3. Joel Hass, Christopher Heil and Maurice D.Weir, "Thomas' Calculus", Pearson, 14th Edition, New Delhi, 2018.
4. Narayanan S. and Manicavachagom Pillai T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
3. Greenberg M.D., “Advanced Engineering Mathematics”, Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
4. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”,Narosa Publications, 5th Edition, New Delhi, 2017.
5. Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi , 2012.
6. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	2							2				
CO2	3	3	3	2	2							2				
CO3	3	3	3	2	2							2				
CO4	3	3	3	2	2							2				
CO5	3	3	3	2	2							2				
Overall CO	3	3	3	2	2							2				

PH5151 **ENGINEERING PHYSICS** **L T P C**

(Common to all branches of B.E / B.Tech programmes) **3 0 0 3**

OBJECTIVE

- To make the students in understanding the importance of mechanics.
- To equip the students on the knowledge of electromagnetic waves.
- To introduce the basics of oscillations, optics and lasers.
- To enable the students in understanding the importance of quantum physics.
- To elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I MECHANICS 9

Moment of inertia (M.I) - Radius of gyration - Theorems of M .I - M.I of circular disc, solid cylinder , hollow cylinder , solid sphere and hollow sphere - K.E of a rotating body – M.I of a diatomic molecule – Rotational energy state of a rigid diatomic molecule - centre of mass – conservation of linear momentum – Relation between Torque and angular momentum - Torsional pendulum.

UNIT II ELECTROMAGNETIC WAVES 9

Gauss's law – Faraday's law - Ampere's law - The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect - reflection and refraction of light waves - total internal reflection - interference - interferometers - air wedge experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser - applications.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - Particle in a infinite potential well - Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Resonant diode - Finite potential wells - particle in a three dimensional box - Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

OUTCOME

After completion of this course, the students should able to

- Understanding the importance of mechanics.
- Express the knowledge of electromagnetic waves.
- Know the basics of oscillations, optics and lasers.
- Understanding the importance of quantum physics.
- Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.

TEXT BOOKS

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
2. D.Halliday, R.Resnick and J.Walker. Principles of Physics. John Wiley & Sons, 2015.
3. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer- Verlag, 2012.

REFERENCES

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson, 2016.
2. D.J.Griffiths. Introduction to Electrodynamics. Pearson Education, 2015
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications. Springer, 2012.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	2											
CO2	3	3	3	2	2											
CO3	3	3	3	2	2											
CO4	3	3	3	2	2											
CO5	3	3	3	2	2											
Overall CO	3	3	3	2	2											

CY5151 **ENGINEERING CHEMISTRY** **L T P C**
(COMMON TO ALL BRANCHES) **3 0 0 3**

OBJECTIVES:

- To introduce the basic concepts of polymers, their properties and some of the important applications.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To facilitate the understanding of the laws of photochemistry, photoprocesses and instrumentation & applications of spectroscopic techniques.
- To familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- To inculcate sound understanding of water quality parameters and water treatment techniques.

UNIT I POLYMER CHEMISTRY 9

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Structure, Properties and uses of: PE, PVC, PC, PTFE, PP, Nylon 6, Nylon 66, Bakelite, Epoxy; Conducting polymers – polyaniline and polypyrrole.

UNIT II NANOCHEMISTRY 9

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties. Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Properties (optical, electrical, mechanical and magnetic) and Applications of nanomaterials - medicine, agriculture, electronics and catalysis.

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law (derivation and problems). Photo physical processes – Jablonski diagram. Chemiluminescence, photo-sensitization and photoquenching – mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. Width and intensities of spectral lines.Atomic absorption spectroscopy, UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

UNIT IV ENERGY CONVERSIONS AND STORAGE 9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant – fast breeder reactor.Solar energy conversion - solar cells. Wind energy. Batteries - types of batteries – primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – H_2-O_2 and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V WATER TECHNOLOGY 9

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD and BOD. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, calgon and carbonate treatment. External conditioning - zeolite (permutit) and ion exchange demineralization. Municipal water treatment process – primary (screening, sedimentation and coagulation), secondary (activated sludge process and trickling filter process) and tertiary (ozonolysis, UV treatment, chlorination, reverse osmosis).

TOTAL: 45 PERIODS

OUTCOMES:

- To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- To identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.
- To recognize different forms of energy resources and apply them for suitable applications in energy sectors.
- To demonstrate the knowledge of water and their quality in using at different industries.

TEXT BOOKS:

1. Jain P. C. & Monica Jain., "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. S.S.Dara, "A text book of Engineering Chemistry", Chand Publications, 2014.

REFERENCE BOOKS:

1. Schdeva M V, "Basics of Nano Chemistry", Anmol Publications Pvt Ltd
2. B.Sivasankar, "Instrumental Methods of Analysis", Oxford University Press. 2012.
3. Friedrich Emich, "Engineering Chemistry", Scientific International Ltd.
4. V RGowariker, N V Viswanathan and JayadevSreedhar, "Polymer Science" New AGE International Publishers, 2009.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	2											
CO2	3	3	3	2	2											
CO3	3	3	3	2	2											
CO4	3	3	3	2	2											
CO5	3	3	3	2	2											
Overall CO	3	3	3	2	2											

GE5151 **ENGINEERING GRAPHICS** **LT PC**
1 0 4 3

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:

1. Drawing free hand sketches of basic geometrical shapes and multiple views of objects.
2. Drawing orthographic projections of lines and planes.
3. Drawing orthographic projections of solids.
4. Drawing development of the surfaces of objects.
5. Drawing isometric and perspective views of simple solids.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNITI PLANE CURVES AND FREE HANDSKETCHING 14

Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by different methods – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNITII PROJECTION OF POINTS, LINES AND PLANE SURFACES 15

Orthographic projection- principles-Principle planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections)inclined to both the principal planes-Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNITIII PROJECTION OF SOLIDS 15

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

UNITIV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES15

Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.

UNITV ISOMETRIC AND PERSPECTIVE PROJECTIONS 12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) 3

Introduction to drafting packages and demonstration of their use

TOTAL (L: 15 + P: 60)=75 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Draw free hand sketching of basic geometrical shapes and multiple views of objects.
2. Draw orthographic projections of lines and planes
3. Draw orthographic projections of solids
4. Draw development of the surfaces of objects
5. Draw isometric and perspective views of simple solids.

TEXT BOOKS:

1. Bhatt, N. D.,Panchal V M and Pramod R. Ingle, "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2014.
2. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

REFERENCES:

1. Agrawal, B. and Agrawal C.M., "Engineering Drawing", Tata McGraw, N.Delhi, 2008.
2. Gopalakrishna, K. R., "Engineering Drawing", Subhas Stores, Bangalore, 2007.
3. Natarajan, K. V., "A text book of Engineering Graphics", 28thEd., Dhanalakshmi Publishers, Chennai, 2015.
4. Shah, M. B., and Rana, B. C., "Engineering Drawing", Pearson, 2ndEd., 2009.
5. Venugopal, K. and Prabhu Raja, V., "Engineering Graphics", New Age,2008.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only.
4. The students will be permitted to use appropriate scale to fit solution within A3 size.
5. The examination will be conducted in appropriate sessions on the same day.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3			1		2	3				
CO2	3	3	3	3	3	3			1		2	3				
CO3	3	3	3	3	3	3			1		2	3				
CO4	3	3	3	3	3	3			1		2	3				
CO5	3	3	3	3	3	3			1			3				
Overall CO	3	3	3	3	3	3			1		2	3				

BS5161 BASIC SCIENCES LABORATORY **L T P C**

(Common to all branches of B.E. / B.Tech Programmes) **0 0 4 2**

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVE

- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.

LIST OF EXPERIMENTS:

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer - Determination of wavelength using gating.
13. Photoelectric effect
14. Michelson Interferometer.
15. Estimation of laser parameters.
16. Melde's string experiment

TOTAL: 30 PERIODS

OUTCOME

Upon completion of the course, the students will be able

- CO1: To determine various moduli of elasticity.
- CO2: To determine the velocity of ultrasonic waves, band gap determination
- CO3: To determine various thermal and optical properties of materials.
- CO4: To determine the viscosity of liquids
- CO5: To determine the estimation of laser parameters

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3											
CO2	3	3	3	3	3											
CO3	3	3	3	3	3											
CO4	3	3	3	3	3											
CO5	3	3	3	3	3											
Overall CO	3	3	3	3	3											

CHEMISTRY LABORATORY: (Minimum of 8 experiments to be conducted)

OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and polymers by spectroscopy and viscometry methods.

LIST OF EXPERIMENTS:

1.Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.

2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler‟s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES:

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To determine the molecular weight of polymers by viscometric method.
- To quantitatively analyse the impurities in solution by electroanalytical techniques
- To design and analyse the kinetics of reactions and corrosion of metals

TEXTBOOKS:

1. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).
2. Vogel‟s Textbook of Quantitative Chemical Analysis (8^{th} edition, 2014).

GE5162 WORKSHOP PRACTICES LABORATORY LT P C
(Common to all Branches of B.E. / B.Tech. Programmes) 0 0 4 2

COURSE OBJECTIVES: The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a) Sawing,
b) Planning and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

WIRING WORK:

a) Wiring Switches, Fuse, Indicator and Lamp etc. such as in basic household,
b) Wiring Stair case light.
c) Wiring tube – light.
d) Preparing wiring diagrams for a given situation.

Wiring Study:

a) Studying an Iron-Box wiring.
b) Studying a Fan Regulator wiring.
c) Studying an Emergency Lamp wiring.

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Studying a FM radio.
b) Studying an electronic telephone.

TOTAL (P: 60) = 60 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
- Wire various electrical joints in common household electrical wire work.
- Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
- Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3				2		1					
CO2	3	3	3	3	3				2		1					
CO3	3	3	3	3	3				2		1					
CO4	3	3	3	3	3				2		1					
CO5	3	3	3	3	3				2		1					
Overall CO	3	3	3	3	3				2		1					

SEMESTER II

HS5251 PROFESSIONALCOMMUNICATION L T P C
4 0 0 4

COURSE OBJECTIVES

The course entitles ‘professional communication ’ aims to,

- Improve the relevant language skills necessary for professional communication.
- Develop linguistic and strategic competence in workplace context.
- Enhance language proficiency and thereby the employability of budding engineers and technologists.

UNIT I TECHNICAL COMMUNICATION 12

Listening: Listening to telephone conversations (intent of the speaker and note taking exercises)- Speaking: Role play exercises based on workplace contexts, introducing oneself- Reading: Reading the interview of an achiever and completing exercises (skimming, scanning and predicting)- Writing: Writing a short biography of an achiever based on given hints- Grammar: Asking and answering questions, punctuation in writing, prepositional phrases- Vocabulary Development: use of adjectives.

UNIT II SUMMARY WRITING 12

Listening: Listening to talks/lectures both general and technical and summarizing the main points- Speaking: Participating in debates- Reading: Reading technical essays/ articles and answering comprehension questions-Writing: Summary writing-Grammar: Participle forms, relative clauses- Vocabulary Development: Use of compound words, abbreviations and acronyms.

UNIT III PROCESS DESCRIPTION 12

Listening: Listening to a process description and drawing a flowchart-Speaking: Participating in Group Discussions, giving instructions- Reading: Reading instruction manuals- Writing: Writing process descriptions- Writing instructions- Grammar: Use of imperatives, active and passive voice, sequence words- Vocabulary Development: Technical jargon

UNIT IV REPORT WRITING 12

Listening: Listening to a presentation and completing gap-filling exercises- Speaking: Making formal presentations- Reading: Reading and interpreting charts/tables and diagrams- Writing: Interpreting charts/tables and diagrams, writing a report- Grammar: Direct into indirect speech, use of phrases- Vocabulary Development: reporting words

UNIT V WRITING JOB APPLICATIONS 12

Listening: Listening to a job interview and completing gap=filling exercises- Speaking: Mock interview, telephone interviews- Reading: Reading a job interview, SOP, company profile and completing comprehension exercises- Writing: job applications and resumes and SOPs-Grammar: Present perfect and continuous tenses- Vocabulary Development: Technical vocabulary.

TOTAL :60 PERIODS

LEARNING OUTCOMES

At the end of the second semester the learners should be able to,

- Read and comprehend technical texts effortlessly.
- Write reports of a technical kind.
- Speak with confidence in interviews and thereby gain employability

Textbook

- Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019. Assessment Pattern
- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-	-	1	1	-	3	3	-	3				
CO2	-	-	-	-	-	1	1	-	3	3	-	3				
CO3	-	-	-	-	-	1	1	-	3	3	-	3				
Overall CO	-	-	-	-	-	1	1	-	3	3	-	3				

MA5252	ENGINEERING MATHEMATICS – II (Common to all branches of B.E. / B.Tech. Programmes in II Semester)	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in Engineering problems.
- To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS **12**

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem, Stoke's theorem and Gauss divergence theorem – Verification and application in evaluating line, surface and volume integrals.

UNIT II ANALYTIC FUNCTION **12**

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear transformation $w = c + z,\ az,\ 1/z,\ z^2$.

UNIT III COMPLEX INTEGRATION **12**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

12

UNIT IV DIFFERENTIAL EQUATIONS

Method of variation of parameters – Method of undetermined coefficients – Homogenous equations of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT V LAPLACE TRANSFORMS **12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals – Initial and Final Value Theorems – Inverse Transforms – Convolution Theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS

OUTCOMES:

Upon successful completion of the course, students will be able to:

- Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
- Construct analytic functions and use their conformal mapping property in application problems.
- Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.
- Apply various methods of solving differential equation which arise in many application problems.
- Apply Laplace transform methods for solving linear differential equations.

TEXTBOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.

2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, New Delhi, 2017.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3				1			3				
CO2	3	3	3	3	3				1			3				
CO3	3	3	3	3	3				1			3				
CO4	3	3	3	3	3				1			3				
CO5	3	3	3	3	3				1			3				
Overall CO	3	3	3	3	3				1			3				

GE5153 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C 3 0 0 3

OBJECTIVES:

- To know the basics of algorithmic problem solving.
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I INTRODUCTION TO COMPUTING AND PROBLEM SOLVING 9

Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudocodesand Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms – Introduction to Python Programming – Python Interpreter and Interactive Mode – Variables and Identifiers – Arithmetic Operators– Values and Types – Statements.

Suggested Activities:

- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic operations.
- Installing Python.
- Simple programs on print statements, arithmetic operations.

Suggested Evaluation Methods:

- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

UNIT II CONDITIONALS AND FUNCTIONS 9

Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs – Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

Suggested Activities:

- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

Suggested Evaluation Methods:

- Tutorials on the above activities.
- Group Discussion on external learning.

UNIT III SIMPLE DATA STRUCTURES IN PYTHON 10

Introduction to Data Structures – List – Adding Items to a List – Finding and Updating an Item – Nested Lists – Cloning Lists – Looping Through a List – Sorting a List – List Concatenation – List Slices – List Methods – List Loop – Mutability – Aliasing – Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value, Nested Tuples, Basic Tuple Operations – Sets.

Suggested Activities:

- Implementing python program using lists, tuples, sets for the following scenario:
  Simple sorting techniques
  Student Examination Report
  Billing Scheme during shopping.
- External learning - List vs. Tuple vs. Set – Implementing any application using all the three data structures.

Suggested Evaluation Methods:

- Tutorials on the above activities.
- Group Discussion on external learning component.

UNIT IV STRINGS, DICTIONARIES, MODULES 10

Strings: Introduction, Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built-In String Functions – Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting, Sorting, Looping, Nested Dictionaries Built-in Dictionary Function – Finding Key and Value in a Dictionary – Modules – Module Loading and Execution – Packages – Python Standard Libraries.

Suggested Activities:

- Implementing Python program by importing Time module, Math package etc.
- Creation of any package (student's choice) and importing into the application.

Suggested Evaluation Methods:

- Tutorials on the above activities.

UNIT V FILE HANDLING AND EXCEPTION HANDLING 7

Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

Suggested Activities:

- Developing modules using Python to handle files and apply various operations on files.
- Usage of exceptions, multiple except blocks -for applications that use delimiters like age, range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.
-

Suggested Evaluation Methods:

- Tutorials on the above activities.
- Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, students will be able to:

1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs.
3. Write simple Python programs for solving problems.
4. Decompose a Python program into functions.
5. Represent compound data using Python lists, tuples, dictionaries etc.
6. Read and write data from/to files in Python programs.

TEXT BOOK:

1. ReemaThareja, “Python Programming using Problem Solving Approach”, Oxford University Press, 2017.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Second Edition, Shroff/O‘Reilly Publishers, 2016. (http://greenteapress.com/wp/thinkpython/).

REFERENCES:

1. Guido van Rossum, Fred L. Drake Jr., “An Introduction to Python – Revised and Updated for Python 3.2”, Network Theory Ltd., 2011.
2. John V Guttag, “Introduction to Computation and Programming Using Python”, Revised and Expanded Edition, MIT Press , 2013
3. Charles Dierbach, “Introduction to Computer Science using Python”, Wiley India Edition, 2016.
4. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, Cengage Learning, 2012.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3						3	3				
CO2	3	3	3	3	3						3	3				
CO3	3	3	3	3	3						3	3				
CO4	3	3	3	3	3						3	3				
CO5	3	3	3	3	3						3	3				
CO6	3	3	3	3	3						3	3				
Overall CO	3	3	3	3	3						3	3				

EE5251 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To understand the basic concepts of electric circuits, magnetic circuits and wiring.
- To understand the operation of AC and DC machines.
- To understand the working principle of electronic devices and circuits.

UNIT I BASIC CIRCUITS AND DOMESTIC WIRING 9

Electrical circuit elements (R, L and C)-Dependent and independent sources – Ohm's Law-Kirchhoff's laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS-Average values-sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires-Earthing-Methods-Protective devices.

UNIT II THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS 9

Three phase supply – Star connection – Delta connection –Balanced and Unbalanced Loads- Power in three-phase systems – Comparison of star and delta connections – Advantages-Magnetic circuits-Definitions-MMF, Flux, Reluctance, Magnetic field intensity, Flux density, Fringing, self and mutual inductances-simple problems.

UNIT III ELECTRICAL MACHINES 9

Working principle of DC generator, motor-EMF and Torque equation-Types –Shunt, Series and Compound-Applications. Working principle of transformer-EMF equation-Operating principles of three phase and single phase induction motor-Applications. Working principles of alternator-EMF equation-Operating principles of Synchronous motor, stepper motor-Applications.

UNIT IV BASICS OF ELECTRONICS 9

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics-Rectifier circuits-Wave shaping.

UNIT V CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES 9

Working principle and characteristics - BJT, SCR, JFET, MOSFET.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 To be able to understand the concepts related with electrical circuits and wiring.
CO2 To be able to study the different three phase connections and the concepts of magnetic circuits.
CO3 Capable of understanding the operating principle of AC and DC machines.
CO4 To be able to understand the working principle of electronic devices such as diode and zener diode.
CO 5 To be able to understand the characteristics and working of current controlled and voltage controlled devices.

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education, 2014
2. Del Toro, “Electrical Engineering Fundamentals”, Second edition, Pearson Education, New Delhi, 1989.
3. John Bird, “Electrical Circuit theory and technology”, Routledge; 5th edition, 2013

REFERENCES:

1. Thomas L. Floyd, ‘Electronic Devices’, 10th Edition, Pearson Education, 2018.
2. Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7th edition, 2017
3. Kothari DP and I.J Nagrath, “Basic Electrical Engineering”, McGraw Hill, 2010.
4. Muhammad H.Rashid, “Spice for Circuits and electronics”, 4thed.,Cengage India,2019.

Course Outcome		Program outcome and Program Specific Outcome														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	1	-	-	-	-	1	-	1				
CO2	3	2	2	1	1	-	-	-	-	1	-	1				
CO3	3	2	2	1	1	-	-	-	-	1	-	1				
CO4	3	2	2	1	1	-	-	-	-	1	-	1				
CO5	3	-	2	1	1	-	-	-	-	1	-	1				
Overall CO	3	2	2	1	1	-	-	-	-	1	-	1				

GE5152 **ENGINEERING MECHANICS** **LTPC**
3104

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:

1. Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Applying the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Applying the concepts of locating centroids/center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Applying the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Applying the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT I STATICS OF PARTICLES (9+3)

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNITII EQUILIBRIUM OF RIGID BODIES (9+3)

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNIT III DISTRIBUTED FORCES (9+3)

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies , Determination of Centroids of Volumes by Integration.

Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration

UNIT IV FRICTION (9+3)

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction.

UNITV DYNAMICS OF PARTICLES (9+3)

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force , Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

TOTAL (L: 45 + T: 15)=60 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Apply the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Apply the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Apply the concepts of locating centroids / center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, SanjeevSanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11thEdition, 2017.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2005.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	3				1		1					
CO2	3	3	3	2	3				1		1					
CO3	3	3	3	2	3				1		1					
CO4	3	3	3	2	3				1		1					
CO5	3	3	3	2	3				1		1					
Overall CO	3	3	3	2	3				1		1					

PH5251 **MATERIALS SCIENCE** **L T P C**

(Common to Mechanical, Manufacturing, Industrial, Mining, Aeronautical, Automobile and Production Engineering& Rubber and Plastics Technology) **3 0 0 3**

OBJECTIVE

- To make the students to understand the basics of crystallography and crystal imperfections.
- To introduce various strengthening methods of materials, and also various mechanical properties and their measurement.
- To impart knowledge on the basics of phase diagrams and their applications.
- To learn about iron-carbon system, and about various ferrous and non-ferrous alloys.
- To introduce the preparation, properties and applications of ceramics, composites and nanomaterials.

UNIT I CRYSTALLOGRAPHY 9

Crystallographic directions and planes – metallic crystal structures: BCC, FCC and HCP – linear and planar densities – crystal imperfections- edge and screw dislocations, Burgers vector and elastic strain energy- surface imperfections – grain and twin boundaries – Polymorphism – phase changes – nucleation and growth – homogeneous and heterogeneous nucleation.

UNIT II MECHANICAL PROPERTIES 9

Tensile test - plastic deformation by slip – slip systems – mechanisms of strengthening in metals: strain hardening, grain size reduction, solid solution strengthening, precipitation hardening – Creep: creep curves,stress and temperature effects, mechanisms of creep, creep-resistant materials – Fracture: ductile and brittle fractures - the Griffith criterion –fracture toughness - Fatigue failure:the S-N curve – factors that affect fatigue life – Hardness: Rockwell and Brinell hardness tests, Knoop and Vickers microhardness tests.

UNIT III PHASE DIAGRAMS 9

Basic concepts - Gibbs phase rule –Unary phase diagram (iron) - Binary phase diagrams: isomorphous systems (Cu-Ni) –determination of phase composition and phase amounts – tieline and lever rule - binary eutectic diagram with no solid solution and limited solid solution (Pb-Sn) –eutectoid and peritectic reactions - other invariant reactions – microstructural development during the slow cooling: eutectic, hypereutectic and hypoeutectic compositions.

UNIT IV FERROUS AND NONFERROUS ALLOYS 9

The Fe-Fe_3C phase diagram: phases, invariant reactions,development of microstructure in eutectoid, hypoeutectoid and hypereutectoid alloys–influence of other alloying elements in the Fe-C system - phase transformations –isothermal transformation diagram for eutectoid iron-carbon alloy – microstructures: pearlite, bainite, spheroidite and martensite – steels, stainless steels and cast irons – copper alloys – aluminum alloys – titanium alloys.

UNIT V CERAMICS, COMPOSITES AND NANO MATERIALS 9

Ceramics – types and applications-refractories, abrasives and cements – Composites: classification, role of matrix and reinforcement -Fiber reinforced composites – carbon-carbon composites – Nanomaterials:types, physical, chemical and mechanical properties - carbon nanotubes: properties and applications - synthesis of nanomaterials: sonochemical, molecular epitaxy, physical vapor deposition (PVD) and chemical vapor deposition (CVD). Characterization: Transmission electron microscopy - scanning electron microscopy - Atomic force microscopy - X-ray powder diffraction - Nanoparticle size calculation.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students will

- understand the basics of crystallography and its importance in materials properties
- understand the significance of dislocations, strengthening mechanisms, and tensile, creep, hardness and fracture behavior of materials
- gain knowledge on binary phase diagrams, and also will be able to determine the phase composition and phase amount.
- understand about the Fe-C system and various microstructures in it, and also about various ferrous and non-ferrous alloys.
- get adequate understanding on the preparation, properties and applications of ceramics, composites and nanomaterials.

REFERENCES

1. W.D.Callitser and D.G.Rethwish. Materials Science and Engineering. John Wiley & Sons, 2014.
2. V.Raghavan. Materials Science and Engineering: A First Course. PHI Learning, 2015.
3. M.F.Ashby, P.J.Ferreira and D.L.Schodek. Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers, 2011.
4. J.F.Shackelford. Introduction to Materials Science for Engineers. Pearson, 2015.
5. D.R. Askeland and W.J.Wright. Essentials of Materials Science and Engineering,Cengage Learning, 2013.
6. W.F.Smith, J.Hashemi and R.Prakash. Materials Science and Engineering. McGraw Hill Education, 2017.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	-	-	-	-	1	-	1	2	-	1				
CO2	2	1	-	-	-	-	1	-	1	2	-	1				
CO3	2	1	-	-	-	-	1	-	1	2	-	1				
CO4	2	1	-	-	-	-	1	-	1	2	-	1				
CO5	2	1	-	-	-	-	1	-	1	2	-	1				
Overall CO	2	1	-	-	-	-	1	-	1	2	-	1				

GE5161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To understand the problem solving approaches.
- To learn the basic programming constructs in python.
- To articulate where computing strategies support in providing python–based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:

1. Identification of Simple real life or Scientific or technical problems; Solve them and develop flow charts for the same.
2. Python programming using Simple statements and expressions
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing Real-time/Technical applications using Lists, Tuples.
5. Implementing Real-time/Technical applications Sets, Dictionaries.
6. Implementing programs using functions.
7. Implementing programs using Strings.
8. Implementing programs using your own modules and Python standard libraries.
9. Implementing Real-time/Technical applications using File handling.
10. Implementing Real-time/Technical applications using Exception handling.
11. Self exploring Pygame.
12. Developing a game activity using Pygame like bouncing ball, etc.

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to:

- Develop algorithmic solutions to simple computational problems
- Developing and executing simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python data structures.
- Applying Python features in developing software applications.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3						3	3				
CO2	3	3	3	3	3						3	3				
CO3	3	3	3	3	3						3	3				
CO4	3	3	3	3	3						3	3				
CO5	3	3	3	3	3						3	3				
CO6	3	3	3	3	3						3	3				
Overall CO	3	3	3	3	3						3	3				

EE5261 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY L T P C
0 0 4 2

OBJECTIVES

1. To impart hands on experience in verification of circuit laws and measurement of circuit parameters
2. To train the students in performing various tests on electrical motors.
3. It also gives practical exposure to the usage of CRO, power sources & function generators

List of Experiments

1. Verification of Kirchhoff's Law.
2. Steady state response of AC and DC circuits (Mesh, Node Analysis)
3. Frequency response of RLC circuits.
4. Measurement power in three phase circuits by two-watt meter method.
5. Regulation of single phase transformer.
6. Performance characteristics of DC shunt generator.
7. Performance characteristics of single phase induction motor.
8. Characteristics of PN diode and Zener diode
9. Characteristics of Zener diode
10. Half wave and full wave Rectifiers
11. Application of Zener diode as shunt regulator.
12. Characteristics of BJT and JFET

TOTAL: 60 PERIODS

OUTCOMES:

1. To become familiar with the basic circuit components and know how to connect them to make a real electrical circuit;
2. Ability to perform speed characteristic of different electrical machines
3. Ability to use logic gates and Flip flop

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	3	-	-	-	2	2	-	1				
CO2	2	2	2	-	2	-	-	-	2	2	-	1				
CO3	3	3	3	-	3	-	-	-	2	2	-	1				
Overall CO	2.6	2.6	2.6	-	2.6	-	-	-	2	2	-	1				

SEMESTER III

MA 5354 PROBABILITY AND STATISTICS L T P C
3 1 0 4

OBJECTIVES

- To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significance of the Central Limit theorem.
- To apply the small/ large sample tests through Tests of hypothesis.
- To understand the concept of analysis of variance and use it to investigate factorial dependence.
- To monitor a process and detect a situation when the process is out of control.

UNIT I RANDOM VARIABLES12

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions – Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTS OF SIGNIFICANCE12

Type I and Type II errors – Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness and Rank – Sum test (Wilcoxon test).

UNIT IV DESIGN OF EXPERIMENTS 12

Completely Randomized Design – Randomized Block Design – Latin Square Design – factorial design – Taguchi's robust parameter design.

UNIT V STATISTICAL QUALITY CONTROL 12

Control charts for measurements ($\bar{X}$ and R charts) – Control charts for attributes (p, c and np charts) Tolerance limits – Acceptance sampling.

TOTAL: 60 PERIODS

OUTCOMES

- To analyze the performance in terms of probabilities and distributions achieved by the determined solutions
- To be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis
- To apply the basic principles underlying statistical inference(estimation and hypothesis testing)
- To demonstrate the knowledge of applicable large sample theory of estimators and tests
- To obtain a better understanding of the importance of the methods in modern industrial processes.

TEXT BOOKS:

1. Devore, J.L. “Probability and Statistics for Engineering and the Sciences”, Cengage Learning, 9th Edition, Boston, 2017.
2. Johnson, R.A. and Gupta, C.B. “Miller and Freund’s Probability and Statistics for Engineers”, Pearson India Education, Asia, 9th Edition, New Delhi, 2017.
3. Walpole, R.E., Myers R.H., Myres S.L., and Ye, K. “Probability and Statistics for Engineers and Scientists”, Pearson Education, Asia, 9th Edition, New Delhi, 2011.

REFERENCES:

1. Krishnaiah, K. and Shahabudeen, P. “Applied Design of Experiments and Taguchi Methods”, Prentice Hall of India, New Delhi, 2012.
2. Milton, J.S. and Arnold, J.C. “Introduction to Probability and Statistics”, Tata McGraw Hill, 4th Edition, 3rd Reprint, New Delhi, 2008.
3. Ross, S.M. “Introduction to Probability and Statistics for Engineers and Scientists”, Elsevier, 5th Edition, New Delhi, 2014.
4. Spiegel, M.R., Schiller, J., Srinivasan, R.A. and Goswami, D., “Schaum’s Outline of Theory and Problems for Probability and Statistics”, McGraw Hill Education, 3rd Edition, Reprint, New Delhi, 2017.

AU5352 **MECHANICS OF SOLIDS** **L T P C**
3 0 0 3

OBJECTIVES:

The objective of this course is

1. To know about how a solid (materials, structures) behaves when it is exposed to forces and deformations.
2. To apply the fundamental concepts of principle of superposition, equilibrium, compatibility, force deformation, and stress-strain relationships to the solid and structural mechanics problems
3. To analyze determinate and indeterminate bars, beams, to determine axial forces, torques, shear forces, and bending moments
4. To have physical insight into distribution of stresses and strains in structural members
5. To identify the biaxial stresses in acting in a body or an element.

UNIT I STRESS - STRAIN, AXIAL LOADING 9

Stress and strain, elastic limit, Hooke's law, factor of safety, shear stress, shear strain, relationship between elastic constants. Stresses in stepped bars, uniformly varying sections, composite bars due to axial force. Lateral strain, Poisson's ratio, volumetric strain, changes in dimensions and volume. Thermal stresses and impact loading.

UNIT II STRESSES IN BEAMS 9

Beam – Definition, types of end supports, types of beam, types of loading. Shear force diagram and bending moment diagram for cantilever, simply supported and overhanging beams under point load, UDL, UVL and moments. Euler beam theory - Bending equation, section modulus, Bending stress in beams–Shear stress in beams.

UNIT III DEFLECTION OF BEAMSAND COLUMNS 9

Governing differential equation - Problems on Double integration method - Macaulay's Method –Moment area method. Concepts of Conjugate Beam method and Method of superposition. Columns – different end conditions – buckling load – Euler's theory – Rankine's formula.

UNIT IV TORSION AND SPRINGS 9 Theory of torsion and assumptions - torsion equation, polar modulus, stresses in solid and hollow circular shafts, power transmitted by a shaft, shafts in series and parallel, deflection in shafts fixed at the both ends. Springs – types, Deflection expression for closed coiled helical spring – Stress in springs - design of springs.

UNIT V BIAXIALSTRESS 9

Principal stresses, normal and tangential stresses, maximum shear stress - analytical and graphical method. Stresses in combined loading. Thin walled cylinder under internal pressure – changes in dimensions – volume. spherical shells subjected to internal pressure – deformation in spherical shells – Lame's theory.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the students are expected to

i. Know about how a solid (materials, structures) behaves when it is exposed to forces and deformations.
ii. Apply the fundamental concepts of principle of superposition, equilibrium, compatibility, force-deformation, and stress-strain relationships to the solid and structural mechanics problems
iii. Analyze determinate and indeterminate bars, beams, to determine axial forces, torques, shear forces, and bending moments
iv. Have physical insight into distribution of stresses and strains in structural members
v. Identify the biaxial stresses in acting in a body or an element.

TEXT BOOKS:

1. James M Gere, Barry J Goodno, "Mechanics of Materials, SI Edition", Ninth Edition, Cengage Learning, 2018
2. Russell C. Hibbeler, "Mechanics of Materials", Tenth Edition, Pearson education, 2017
3. Stephen Timoshenko, 'Strength of Materials', Vol I & II, CBS Publishers and Distributors, 3rd edition, 2004.

REFERENCES:

1. Clive L. Dym , Irving H. Shames, "Solid Mechanics : A Variational Approach, Augmented Edition", Springer publishers, 2013
2. Roy R Craig, "Mechanics of Materials", Third Edition, John Wiley & Sons, 2011
3. R.K.Rajput, 'Strength of Materials', S Chand; 4th Rev. Edition 2007.
4. Timothy A. Philpot, "Mechanics of Materials: An Integrated Learning System," 3rd Edition, Wiley, 2012.
5. William A. Nash, Merle C. Potter, "Schaum's Outline of Strength of Materials", 6th Edition, McGraw Hill Education, 2014

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3															
CO2	3															
CO3	3	3	3	3		2	2									
CO4	3	3	3	3		2	2									
CO5	3	3	3	3		2	2									
Overall CO	3	3	3	3		2	2									

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5301 INTRODUCTOPOLYMER SCIENCE L T P C
3 0 0 3

OBJECTIVES

To impart knowledge to the students in the following

- Basic organic chemistry reactions
- Fundamentals of polymer science
- Mechanism of free radical, Ionic and copolymerization
- Mechanism and kinetics of step – wise polymerization
- Determination of solution properties of polymers

UNIT I BASIC ORGANIC CHEMISTRY 10

Covalent bond: Hybridization Reaction mechanisms - Polarity of bonds-inductive mesomeric and electromeric effects, resonance, hyper conjugation, steric effects, classification of organic reactions, reaction intermediates: free radicals, carbocations and carbanions, properties and applications of Amines, Aniline, CS_2, furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline, imidazoles, thiazoles

UNIT II CHAIN POLYMERIZATION - I 10

History of Macromolecules - Classifications of Polymers – Natural and synthetic polymers – Structure of natural rubber and proteins - Synthetic monomers – Functionality, Polymerization mechanism- Initiation – Types of initiation – Free radical polymerization - Cationic polymerization – Anionic polymerization, Copolymerization - kinetics and classification - Degree of polymerization and molecular weight

UNIT III CHAIN POLYMERIZATION - II 8

Coordination polymerization – Electrochemical polymerization- Metathetical- RAFT polymerization- Atom transfer polymerization - Group transfer Polymerization, Metallocene - photo polymerization, Industrial polymerization – Bulk, emulsion, suspension and solution polymerization techniques

UNIT- IV STEP POLYMERIZATION 8

Polycondensation – Flory's equal reactivity principle – Kinetics of Polycondensation - Carother's equation – Linear polymers by Polycondensation – Interfacial polymerization – Crosslinked polymers by condensation – Gel point –Examples - Moulding powders - Industrial polymerization techniques

UNIT- V SOLUTION PROPERTIES OF POLYMERS 9

Polymer Dissolution - Difference between simple solutions and polymer solutions – Molecular Weight - Average molecular weight – Molecular weight distribution – Polymer fractionation-Polydispersity – Molecular weight determination. Different methods – Gel Permeation Chromatography – Osmometry, Light Scattering – Basic Principles

TOTAL: 45 PERIODS

COURSE OUTCOMES

The students will be able to.

- Understand the basic mechanisms of organic chemistry
- Acquire knowledge on fundamentals of polymer chemistry
- Analyze the mechanism of addition polymerization in the synthesis of various polymers and polymerization techniques.
- Understand the mechanism of step - polymerization in the synthesis of moulding powders
- Able to calculate the molecular weight of polymers

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	3		3	3					2	3		3	3
CO2	3	3	3	3		3	3					2	3		3	3
CO3	3	3	3	3		3	3					2	3		3	3
CO4	3	3	3	3		3	3					2	3		3	3
CO5	3	3	3	3		3	3					2	3		3	3
Overall CO	3	3	3	3		3	3					2	3		3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

REFERENCES

1. Morrison and Boyd, Organic Chemistry Prentice Hall, 1992
2. Finar I.L., Textbook of Organic Chemistry, ELBS, 1996.
3. Seymour.R.B., and Carraher.C.E., Jr., Polymer Chemistry, 2nd Ed., Marcel Dekker, 1988.
4. Gowariker.V.T.,Viswanathan.N.V., and Sreedar.J., Polymer Science, 1988.
5. Joel,R.F; Polymer Science and Technology, Eastern Economy Edition, 1999.
6. George Odian , " Principles of Polymerisation", John Wiley& Sons, 2004.
7. Paul .J.Flory, "Principles of Polymer Chemistry" Cornell University Press, 1995.
8. Robert.O.Ebewele, " Polymer Science and Technology," CRC Press, 2000.

AU5351 THERMODYNAMICS AND THERMAL ENGINEERING L T P C
3 1 0 4

OBJECTIVES:

i. To impart knowledge of basic principles of thermodynamics via real world engineering examples
ii. To analyse and evaluate cardinal air standard cycles
iii. To analyse and evaluate cardinal Steam power cycles
iv. Summarize the governing concepts of Refrigeration and Air conditioning
v. To introduce various modes of heat transfer, related to real time scenarios of thermodynamics applied in engineering practice

UNIT I BASIC THERMODYNAMICS 12

Systems, closed, open and isolated. Property, state, path and process, quasi-static process, Zeroth low, First law. Steady flow energy equation. Engineering Applications of Steady flow energy equation Heat and work transfer in flow and non-flow processes. Second law, Kelvin-Planck statement – Clausius statement - Concept of Entropy, Clausius inequality, Entropy change in non-flow processes. Availability and Un Availability. Properties of gases and vapours

UNIT II AIR STANDARD CYCLES AND COMPRESSORS 12

Cycle, Carnot cycle, Otto, Diesel, Dual combustion and Brayton cycles. Air standard efficiency. Mean effective pressure. Comparison of cycles, Efficiency versus compression ratio, For the same compression ratio and the same heat input Compressors, Classifications of compressors, Single stage and multi stage, Effect of intercooler in multi stage compressor, Perfect and imperfect intercooler, work done by the compressor, Reciprocating, Rotary, Axial, Vane compressors.

UNIT III STEAM AND JET PROPULSION 12

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface

Properties of steam, Dryness fraction, Quality of steam by steam tables and Mollier chart – Rankine cycle, Work done, Steam rate – Steam Nozzles, Types of nozzles, Friction in nozzles - Simple jet propulsion system – Thrust rocket motor – Specific impulse.

UNIT IV REFRIGERATION AND AIR-CONDITIONING 12

Principles of refrigeration, Vapour compression – Types of VCR system with respect to condition of vapour, Problems, Vapour absorption types, comparison - Co-efficient of performance (COP), Properties of refrigerants – Basic Principle, Summer, winter and Year round Air conditioning.

UNIT V HEAT AND MASS TRANSFER 12

Modes of heat transfer, Heat conduction in parallel, radial and composite wall – Heat conduction through hollow and composite cylinders, spheres. Basics of Convective heat transfer. Fundamentals of Radiative heat transfer – Flow through heat- exchangers, Logarithmic Mean Temperature Difference (LMTD) for parallel flow and Arithmetic Mean Temperature Difference (AMTD) counter flow heat exchangers.

TOTAL: 60 PERIODS

(Use of standard Steam tables with mollier chart and Refrigerant tables are permitted)

OUTCOMES:

i. Will demonstrate understanding of the nature of the thermodynamic processes for pure substances of ideal gases
ii. Will interpret First Law of Thermodynamics and its application to systems and control volumes
iii. Will solve any flow specific problem in an engineering approach based on basic concepts and logic sequences.
iv. Will compare and contrast between various types of refrigeration cycles
v. Will get exposed to the basics and modes of heat transfer

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	1	1	-	2	2	-	3				
CO2	3	3	3	3	3	1	1	-	2	2	-	3				
CO3	3	3	3	3	3	1	1	-	2	2	-	3				
CO4	3	3	3	3	3	1	1	-	2	2	-	3				
CO5	3	3	3	3	3	1	1	-	2	2	-	3				
Overall CO	3	3	3	3	3	1	1	-	2	2	-	3				

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

TEXT BOOKS:

1. Chattopadhyay. P Engineering Thermodynamics", oxford University Press, New Delhi, 2010.
2. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2007.
3. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics" Prentice-Hall India, 2005.

REFERENCES:

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
2. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 2007.
3. Mathur& Sharma Steam Tables, Jain Publishers, New Delhi.
4. Merala C, Pother, Craig W, Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.
5. Ramalingam K.K. "Thermodynamics", Sci-Tech Publications, 2006

AE5351 FLUID MECHANICS AND FLUID MACHINES

L T P C
3 0 0 3

OBJECTIVES:

Of this course are

1. To learn about the basic properties of fluids.
2. To introduce the concept of incompressible and viscous flows.
3. To have a thorough knowledge on dimensional analysis and model studies.
4. To study the applications of conservation laws to flow through pipes and hydraulic machines.
5. To learn the basics of water turbines, their classification and working principles.

UNIT I BASIC EQUATIONS 9

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume-application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications.

UNIT II INCOMPRESSIBLE VISCOUS FLOW 9

Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 9

Need for dimensional analysis–methods of dimension analysis–Similitude–types of similitude Dimensionless parameters–application of dimensionless parameters–Model analysis.

UNIT IV PUMPS 9

Euler's equation – Theory of Roto dynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump–working principle.

UNIT V TURBINES 9

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube Specific speed, unit quantities, performance curves for turbines – governing of turbines.

TOTAL: 45 PERIODS

OUTCOMES: Upon completion of the course, Students will be able to

CO1: Exhibit the basic understanding on fluid properties and fluid statics.

CO2: Demonstrate the understanding in fluid kinematics and governing equations.

CO3: Use the governing equations for fluid flow problems and understand the elementary plane flows.

CO4: Analyse laminar and turbulent flow problems.

CO5: Acquire knowledge on the various types of fluid machines.

TEXT BOOKS:

1. Ojha C.S.P, Berndtsson R and Chadramouli P. N., Oxford University Press, 2010
2. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India,2nd Edition, 2007
3. Subramanya K,' Theory and Applications of Fluid Mechanics',Tata McGraw Hill,1993.
4. YunusA.Cengel and John M.Cimbala, Fluid Mechanics, McGraw Hill, 2nd, Edition, 2013.

REFERENCES:

1. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi, 9th edition,2015.
2. Kumar. K.L. Engineering Fluid Mechanics (VII Ed.) S Chand publishers 2006 edition Reprint Edition (1 December 2010).
3. Ramamurtham. S, Hydraulics, Fluid Mechanics and Fluid Machines, Dhanpat Rai Publishing Co Pvt., Ltd, 9th edition, 2012.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	2	1	1	1	1	1	1	1				
CO2	2	2	1	2	2	1	1	1	1	1	1	1				
CO3	3	3	1	2	1	1	1	2	3	1	1	1				
CO4	3	2	1	3	1	1	1	1	1	1	1	1				
CO5	2	3	1	2	2	2	2	2	1	1	2	1				
Overall CO	2.4	2.2	1	2	1.6	1.2	1.2	1.4	1.4	1	1.2	1				

RP5311 **POLYMER SCIENCE LAB** **L T P C**
0 0 4 2

OBJECTIVES

To make the students to acquire practical skills in the following:

- Identification of different plastics materials
- Synthesis of different plastics materials by various polymerization techniques
- Determination of density& Molecular weight of polymers
- Determination of EEW of epoxy resin and acid value of polyester resin

LISTOF EXPERIMENTS

1. Synthesis of Polymers.
2. Bulk polymerization - Preparation of Polymethyl methacrylate.
3. Solution Polymerization - Preparation of polyacrylamide
4. Preparation of Phenol-Formaldehyde, UF and MF resins.
5. Density Determination
6. Identification of Polymers
7. Measurementofviscosityofpolymersolutionsanddeterminationofmolecularweightof the polymer.
8. Determination of K value of PVC
9. Determination of acid value of a Polyester resin.
10. Determination of EEW
11. Study of Molecular weight distribution (GPC)
12. Study ofThermal Stability of polymers

TOTAL: 60 PERIODS

COURSE OUTCOMES:

- Capability to identify plastics materials
- Able to synthesize various types of polymers
- Able to measure viscosity of polymer solutions.
- Able to determine molecular weight and density of polymers.

REFERENCES

1 ASTM Standards, Vol. 8 & 9, ASTM Internation, 1995.

2 Ashraf S.M, Sharif Ahamed, UfanaRiaz, " A Laboratory Manual of Polymers", I.K International Publishing House Pvt Ltd, 2009

3. Stanley R. Sandler, Wolf Karo, JoAnne Bonesteel, Eli M. Pearce," Polymer Synthesis and Characterization: A Laboratory Manual," Academic Press, 1998.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3		1	3				3	1	3	3	1	1	2
CO2			3	3			2				2					
CO3	3	3	3	3	1	3	3	2	3	3	3	2		2	3	3
CO4	3		2	3	1						2					
Overall CO	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

AU5361 MECHANICAL SCIENCES LABORATORY L T P C
0 0 4 2

OBJECTIVES

- To understand the various physical characterization and mechanical properties of materials
- To examine the various testing methods of mechanical properties
- To evaluate the basics of internal combustion engine and its performance characteristics
- To measure the performance characteristics of pumps
- To evaluate the flash and fire points of various fuels which may be used as an alternative fuel in IC engine

LIST OF EXPERIMENTS

1. Tension test
2. Torsion test
3. Testing of springs
4. Impact test i) Izod ii) Charpy
5. Hardness test i) Vickers ii) Brinell iii) Rockwell iv) Shore
6. Deflection of beams
7. Performance test on a 4 stroke diesel engine
8. Mass moment of inertia of connecting rods
9. Valve timing of a 4 stroke engine
10. Port timing of a 2 stroke engine
11. Determination of kinematic and dynamic viscosity of given oil blend
12. Determination of flash point and fire point of given fuel sample

TOTAL: 60 PERIODS

OUTCOMES:

Student able to perceive,

- Understand the various physical characterization and mechanical properties of materials
- Examine the various testing methods of mechanical properties
- Evaluate the basics of internal combustion engine and its performance characteristics
- Measure the performance characteristics of pumps
- Evaluate the flash and fire points of various fuels which may be used as an alternative fuel in IC engine

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3								3	2		2				
CO2		2		2	1				3	2		2				
CO3		2	2	2	1	2	2	1	3	2		2				
CO4				2	1	2	2		3	2		2				
CO5				2		2	2	1	3	2		2				
Overall CO	3	2	2	2	1	2	2	1	3	2		2				

GE5251 ENVIRONMENTAL SCIENCES L T P C
3 0 0 3

OBJECTIVES

- To the study of nature and the facts about environment.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.

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UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c)Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards– soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water 45 logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act– Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course:

CO1: Public awareness of environment at infant stage.
CO2: Ignorance and incomplete knowledge has lead to misconceptions.
CO3:Development and improvement in standard of living has lead to serious Environmentaldisasters.
CO4: Can understand the various acts about prevention and control of pollution.
CO5: Acquire knowledge about human population and human values.

TEXT BOOKS:

1. Benny Joseph, “Environmental Science and Engineering” , Tata McGraw-Hill, New Delhi, 2006
2. Gilbert M. Masters, “Introduction to Environmental Engineering and Science” , 2nd edition, Pearson Education 2004

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, “Environmental Encyclopedia”,Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, “Environmental law” , Prentice hall of India PVT LTD,New Delhi, 2007.
3. Rajagopalan, R, ‘” Environmental Studies-From Crisis to Cure”, Oxford University Press 2005.
4. Trivedi.R.K., ‘Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standard” , Vol. I and II, Enviro Media
5. ErachBharucha “Textbook of Environmental Studies for Undergraduate Courses” Orient Blackswan Pvt. Ltd. (2013).

RP5401 PHYSICAL PROPERTIES OF POLYMERS L T P C
3 0 0 3

OBJECTIVES

To impart knowledge to the students in the following:

- On different states of polymer systems in bulk
- Comparative evaluation of properties of polymers with conventional materials
- Concepts of tribology and their significance in polymer systems
- Relationship between structure and electrical properties in polymers
- Specialty properties of polymers and their applications

UNIT I STATES OF AGGREGATIONS IN POLYMERS 9

Glassy and rubbery states - Segmental mobility and glass transition Temperature - Thermodynamics and significance - Factors affecting transitions - Multiple transitions–Semi crystalline state - Requirements for crystallization - Crystallization from polymer solutions and melts-Crystal nucleation and growth- Effect of crystallization on polymer properties - Degree of crystallinity - Relationship between Tg and Tm - Non-Newtonian behaviour of polymer melts

UNIT II DEFORMATION & FAILURE IN POLYMERS 9

Stress – strain properties of polymers - Comparison with conventional materials - Short term mechanical properties - Flexural strength - Impact strength - Fatigue endurance - Ductile and Brittle failure - Ductile-Brittle transitions - Long term mechanical properties - Creep and Stress relaxation - Boltzmann Superposition principle - Effect of temperature on properties of polymers - viscoelastic properties - Time-Temperature superposition- crazing and cracks and their role in fracture – Fracture and microstructure

UNIT III TRIBOLOGICAL PROPERTIES OF POLYMERS 9

Theory of Friction – surface and bulk material characteristics affecting coefficient of friction-Static and Dynamic Coefficient of friction – Factors affecting Friction in polymers – Elastic deformation – single contacts – multiple contacts – Rolling friction – sliding friction of rubbers and rigid polymers – lubrication by fluids – solid lubricants - Thermoset and thermoplastics composites in Friction related applications - Friction and wear in artificial joints - wear - adhesive wear – Cohesive wear –Wear factor - Wear Testing

UNIT IV ELECTRICAL AND OPTICAL PROPERTIES OF POLYMERS 9

Volume and surface resistivity - Polar and Non-polar polymers - Polarization - Dielectric properties of polymers - Factors affecting dielectric properties - Dielectric relaxation spectroscopy in polymers - Dielectric breakdown- Anti static and conducting polymers - Optical applications of polymers - Reflection - Refraction - Light scattering - Light transfer and Absorption - Rheoptical properties - Photoelastic effects and analysis in polymers - Birefringence and orientation in polymers

UNIT V ENVIRONMENTAL AND SPECIALITY PROPERTIES 9

Barrier properties: Sorption, Diffusion and Permeation - Chemical resistance, Thermal stability and photo degradation in Polymers - Flammability Characteristics - magneto-rheological behaviour in polymer systems - Properties and applications of polyelectrolytes - properties and applications of hydrogels - Piezoelectric properties of polymers - Shape memory polymer systems - Ablative plastics and their applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able to:

- Classify polymers based on their amorphous and crystalline states
- Understand the effects of viscoelasticity on the performance properties of polymers
- Relate the tribological properties with the performance and failure of polymers in friction related applications
- Choose a dielectric material for a given set of operating conditions
- Identify polymer based novel applications

REFERENCES:

1. Ulrich Eisele, Introduction to Polymer Physics Springs – Verlag, New York, 1990.
2. Bill Meyer.F.W. Text Book of Polymer Science, Wiley Interscience Publications, 1994.
3. L.H.Sperling, Introduction to Physical Polymer Science, 4th edition, Wiley Interscience, 2006
4. GertStrobl, The Physics of Polymers, Springer – Verlag 2010
5. Brydson's, Plastics Materials, 8th edition, Marianne Gilbert Butterworth-Heinemann 2016.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	1	-	1	-	-	1	2	2	3	2	2	1
CO2	3	3	3	3	2	-	2	-	2	1	2	2	3	3	2	1
CO3	3	3	3	3	3	-	3	-	2	1	3	3	3	2	2	2
CO4	3	3	3	3	2	-	1	-	2	1	3	2	3	2	1	1
CO5	3	3	3	2	2	-	3	-	3	1	1	2	3	2	2	1
Overall CO	**3**	**3**	**3**	**3**	**2**	**-**	**2**	**-**	**2**	**1**	**2**	**2**	**3**	**2**	**2**	**1**

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5402 INTRODUCTION TO CHEMICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES

To impart knowledge to the students in the following:

- Fundamental concepts of heat transfer and their applications
- Thermodynamic property relations and their application to fluid flow
- Mass transfer Concepts in the design of Distillation columns,Cooling tower and Dryers
- Particle size reduction and also working principles of different equipmentsthat are used for various mechanical operations

UNIT-I HEAT TRANSFER 9

Classification of Unit Operations - Heat transfer – steady state – Fourier law – thermal conductivity – conduction through plane wall – cylindrical wall – convection – forced and natural convection – radiation – unsteady state heat transfer -exchange equipment – double pipe and shell and tube heat exchangers,condensers

UNIT- II BASIC THERMODYNAMICS 9

Thermodynamic Systems and variable - work, heat, internal energy, thermodynamic equilibrium, reversible and irreversibleprocesses - Equation of state - First law - closed and open systems Steady flow energy equation. Second law, - Concept of Entropy, isentropic efficiency, Maxwell's relation and fluid properties - application to flow processes

UNIT-III MASS TRANSFER 9

Mass Transfer –Material Balance - Principles of diffusion, Fick’s law – theory of diffusion, Mass transfer coefficients and film theory Penetration theory. Distillation – Vapour liquid equilibria, Simple distillation, Steam distillation, Continuous binary distillation, Industrial equipment for distillation- industrial boilers

UNIT-IV AGITATION AND DRYING 9

Agitation of liquids – Types of impellers, Selection criteria, Power consumption calculations for agitated vessel Absorption – Principle and equipment (packed towers and plate columns). Adsorption – Principles and equipment for adsorption
Drying – Principles and definitions, Rate of batch drying, Equipments for drying.Humidification –dry bulb and wet bulb temperatures, Equipment —- cooling towers, spray chambers

UNIT-V SEPARATION PROCESSES 9

Membrane Separation Processes - Separation of gases and liquids, Dialysis, Membranes, liquid – liquid extraction, Pervaporationand reverse osmosis.Size reduction Laws of crushing, Equipment – Classification, Crushers and grinders.Mechanical separations – Screening and screening equipments, Filtration – Principle and filtration equipment, filter media, filter aids, Gravity settlers, Cyclones and hydro cyclones.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Students introduced to various types of unit operation in chemical industries.
- Students get an understandingon the basics of heat and mass transfer mechanism
- Students will apply the principles of heat and mass transfer in rubber and plastics processing
- Students will able to comprehend the agitation of liquids, absorption and adsorption and machinery used for the process.
- To get the overview of equipment used to perform various mechanical operations and problems associated during implementation and applications

REFERENCES:

1. Mc. Cabe, W.L., Smith, J.C., Unit Operations of Chemical Engineering, Mc.Graw Hill. 1993.
2. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, Mc.Graw Hill, UK, 1997.
3. Richardson and Coulson, Chemical Engineering, Vol. 1 & vol.2, Asian Books Pvt. Ltd., India. 1996.
4. Chattopadhyay, P., Unit Operations of Chemical Engineering Vol. I and Vol. II, Khanna Publishers, Delhi, 1998.
5. J M Smith, H.C.Van Ness and M.M. Abbott, "Introduction to Chemical Engineering Thermodynamics" 6th edition McGraw Hill, 2001

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2	3		3	3	1	3	2	3	2	1	2			2
CO2	3	2								2			3			
CO3	3		2	3	3		3			3			3	3		3
CO4		3			3	2		3		3					1	
CO5	3	3		2		2		3	2		2		3	3		
Overall CO	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**1**	**3**	**3**	**1**	**3**

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5403	RUBBER MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concept of flexible polymer chains and difference between rubbers, plastics and fibres in terms of Tg
- To appreciate the influence of chemical structure on various properties of rubbers
- To acquire basic knowledge of Natural rubber–production, properties & uses
- To become familiar with manufacture, properties and uses of synthetic and high Performance rubbers
- To become familiar with the concept, manufacture and properties of TPE's

UNIT - I INTRODUCTION 9

Rubber Elasticity – Requirements for rubber elasticity- flexible chain and Tg- Effect of chemical structure on theproperties of rubbers - Natural Rubber Latex, tapping, processing, properties and applications – Conversion of Latex into dry rubber – Properties of dry rubber – Classification based on technical specifications – mastication of NR

UNIT - II DIENE RUBBERS 9

Modifications of Natural Rubber–Applications –epoxidised natural rubber - Synthetic polyisoprene- SBR-solution SBR-recent advances in solution SBR – BR-Polyalkenamers and polynorbornene-Nitrile Rubber NBR-PVC blends, Butyl Rubber, halobutyl rubber, Polychloprene Rubbers

UNIT - III SPECIAL PURPOSE ELASTOMERS 9

Ethylene Propylene Rubber and Ethylene – Vinyl acetate copolymers – Elastomers based on modified polyethylene – Acrylate rubbers Polysulphide rubbers- polyether rubbers – selection criteria for the special purpose rubbers for various applications

UNIT - IV HIGH PERFORMANCE ELASTOMERS 9

HNBR- Fluoroelastomers-VDF based fluoro rubbers-perfluoro rubbers- base resistant rubbers- silicone elastomers- Preparation, structure, properties and applications – liquid silicone rubbers – silicones in medical applications

UNIT -V POLYURETHANESANDTHERMOPLASTIC ELASTOMERS 9

Poly urethanes- diisocyanates, polyols and chain extenders – castable PUs-millable PUs-Requirements for thermoplastic elastomeric behaviour – SBS and SIS Block copolymers – Thermoplastic Polyurethane elastomers – Thermoplastic-co-polyesters – Thermoplastic elastomers based on Plastic – Rubber Blends – Dynamic Vulcanization.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

- Differentiate between rubbers, plastics and fibres in terms of Tg
- Relates chemical structure to performance and processing properties of rubbers
- Get knowledge about preparation, properties and uses of various rubbers
- Understands the importance of TPEs, their preparation and properties and uses
- Suggest rubbers for specific end uses

TEXT BOOK:

1. Kothandaraman B, Rubber Materials, Ane Books, New Delhi, 2007

REFERENCES

1. Brydson, J.A., Rubber Chemistry, Allied science Publishers, London, 1978.
2. Morton.M., Rubber Technology, Chapman Hall, 1995.
3. Franta, Elastomers and Rubber Compounding materials, Elsevier, 1989.
4. Klingender R.C, Handbook of speciality elastomers, CRC Press, 2008.

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	--	--	-	-	--	--	---	---	1	3	--	--	3
CO2	3	1	1	--	--	1	1	--	--	---	----	1	3	--	1	3
CO3	3	-	-	--	--	1	1	--	--	--	----	1	3	--	1	3
CO4	3	1	--	--	--	1	1	--	--	--	---	1	3	--	1	3
CO5	3	-	--	-	--	1	1	--	--	--	-----	2	3	--	1	3
Overall CO	3	1	1	-	--	1	1	--	--	---	----	1	3	--	2	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP 5404 PLASTICS MATERIALS

L	T	P	C
4	0	0	4

OBJECTIVES

To impart knowledge to the students in the following:

- Classification of polymers
- Preparation, properties and uses of PE and PP
- Styrenics and acrylics preparation, properties and uses
- PVC technology
- Additives for plastics

UNIT- I INTRODUCTION TO PLASTICS 12

Plastics – Classification – Structure – Property relationship (effect on thermal, mechanical, optical, chemical, Barrier& electrical properties)

UNIT - II OLEFINIC PLASTICS 12

Manufacturing methods – structure / property relationships, processing & applications of PE, PP & Copolymers of PE & PP– Metallocene polymers

UNIT - III STYRENICS & ACRYLICS 12

Styrenics: Manufacturing methods – Structure - property relationship, processing & applications of PS, SAN, ABS, HIPS & EPS.

Acrylics: Manufacturing Methods – Structure - property relationship processing & applications of PAN, PMMA & their copolymers

UNIT - IV PVC ANDFLOURO PLASTICS 12

Manufacturing, Structure - property relationship, additives for PVC - Processing applications of pPVC, uPVC,, PVC pastes, co polymers of PVC, blends & alloys of PVC, Testing of PVC resin, PVC compounds & Products, flourine containing polymers

UNIT – V ADDITIVESFOR PLASTICS 12

Fillers – Antioxidants – Stabilizers – Lubricants – Plasticizers – Toughening Agents – Colourants – Fire Retardants – Coupling Agents – Blowing Agents – UV Stabilizers – Anti Static Agents – Anti blocking Agents – Slip and Anti slip agents – processing aids – mould releasing agents– miscellaneous additives – environmental regulations - bio degradation of plastics

TOTAL: 60 PERIODS

OUTCOMES:

Students will be able to

- Understand classification of polymers
- Know the properties and applications of PE and PP
- Understand the properties and applications of PS,PVC and acrylics
- Select an appropriate polymer for the required application
- Demonstrate the necessity for new material development to replace the existing one.

REFERENCES

1. Brydson.J.A., Plastics Materials, 7th edition Elsevier Publication, 1999
2. Athalye& Prakash Trivedi, PVC Tech, Multitech Publishing Co, Bombay,1994.
3. Geoffrey Pritchard, “Plastics Additives”, Rapra Technology Ltd, UK, 2005.
4. OlagokeOlabisi, “Hand Book of Thermoplastics”, Marcel Decker, inc., 1997
5. Irvin.I. Rubin, “Hand Book of Plastic Materials and Technology”, Wiley Interscience, NY,1990.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3		3	3					2	3		3	3
CO2	3	3	3	3		3	3					2	3		3	3
CO3	3	3	3	3		3	3					2	3		3	3
CO4	3	3	3	3		3	3					2	3		3	3
CO5	3	3	3	3		3	3					2	3		3	3
Overall CO	3	3	3	3		3	3					2	3		3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5411 **CAD PRACTICE LAB** **L T P C**
1 032

OBJECTIVES

To make the students to:

- Understand the concepts of drawing
- Construct the machine elements
- Assemble the drawing by computer drafting
- Use dimensions with standard dimensioning rules.
- Allocate geometrical tolerances and to develop part drawing.

Introduction to machine drawing & production drawing- classification of drawing- Standardization – Orthographic and isometric projections- Conversion of orthographic to isometric drawing and vice versa- sectional views. Reviews of the concepts of limits, tolerance, fits, surface roughness, and symbols terminology used in Production drawing.

COMPUTER AIDED PRODUCTION DRAFTING

Detailed part drawing and assembly drawings (with suitable tolerances, machine symbols, specification of fit).

1. Screw jack
2. Connecting rod Assembly
3. Plummer block
4. Machine vice
5. Stop valve
6. Universal coupling and knuckle joint
7. Hydraulic & Pneumatic Assembly
8. Injection moulding toggle type clamping
9.PolymerizationPlant Layout - I
10. Polymerization Plant Layout - II **TOTAL: 60 PERIODS**

OUTCOMES

Students will be able to:

- Describe and identify the parts, to choose the functions and operations of a CAD system and draw up specifications.
- Know the different techniques of graphical representation for simple parts and assemblies
- Apply the correct current technical drawing rules.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	2	3	1	-	1	1	1	2	1	3	1	-	1
CO2	3	3	2	3	3	1	-	1	-	1	1	1	3	1	-	1
CO3	2	2	3	3	2	-	-	1	1	-	1	1	2	1	-	-
Overall CO	3	3	3	3	3	1	-	1	1	1	1	1	3	1	-	1

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

TEXT BOOK

1. Narayana K.L., Kannaiah P and Venkata Reddy – “Production Drawing” New age International Limited, Delhi 2004.

REFERENCES

1. Bhat N.D., “Machine Drawing”, Charotar Publishing House, Anand 2000
2. Nagtal G.R., “Machine Drawing”, Khanna Publishers, New Delhi 1994.
3. Sache Singh & P.L. Shah – Fundamentals of Machine Drawing, Prentice Hall India,2003

RP5412 **RUBBER MATERIALS LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES

- To make the familiarize with simple quality control test for the given rubber latex.
- To perform simple tests for identification of elastomers.
- To carry out tests related to properties of rubber and its additives.

LIST OF EXPERIMENTS

1. Determination of Total Solids Content, Dry Rubber Content., KOHnumber of natural rubber Latex
2. Estimation of total alkalinity of the latex
3. Determination of volatile matter, dirt, ash content in Rubber from Natural sources
4. Estimation of Cu, Fe and Mn in rubber by colorimetry
5. Rubber identification pyrolysis and spot test by specific reagents
6. Soxhlet extraction – determination of total extractables
7. Rapid reflux extract
8. Chemical analysis of synthetic rubber components and vulcanisates
9. Determination of structure of carbon black
   (i) DBP absorption, (ii) IAN (iii) Surface area Calculation
10. Estimation of total and free sulphur in rubber products
11. Estimation of process oils
    (i) Aniline point, (ii) Flash point(iii) Viscosity(iv)Density
12. Characterization of accelerator, insoluble methanol.
13. Knowledge about Spectroscopy – UV – Vis and FTIR
14. TGA / DSC analysis of Rubber Compounds.
15. TLC Analysis

TOTAL: 60 PERIODS

OUTCOMES

- Identification of rubber
- Analyze the physical properties of NR latex.
- Chemical analysis of synthetic rubber
- Able to carry out the specifications test and interpretation of data's of various rubbers

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	2	3			2		3	3		3	2	1		
CO2		3	2	3	2		2		2	3		2			2	1
CO3	3	3		2		1			2		1	1	3		1	2
CO4	3	2	3	3			2		2		1	2	3	2		1
Overall CO	**3**	**3**	**2**	**3**	**2**	**1**	**2**		**2**	**3**	**1**	**2**	**3**	**2**	**2**	**2**

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

MG5451 **PRINCIPLES OF MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers- managerial roles and skills – Evolution of Management –Scientific, human relations , system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling .
CO2: Have same basic knowledge on international aspect of management.
CO3: Ability to understand management concept of organizing.
CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept of controlling.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	2	2	2	2	2	-	3	2				
CO2	2	-	-	-	2	2	2	2	2	-	3	3				
CO3	3	-	-	-	3	3	2	2	2	-	3	2				
CO4	2	-	-	-		2	2	2	3	3	3	2				
CO5	3	-	-	-	3	3	2	2	2	-	3	2				
Overall CO	2.6				2.5	2.4	2	2	2.2	3	3	2.2				

TEXT BOOKS:

Harold Koontz and Heinz Weihrich “Essentials of management” Tata McGraw Hill,1998.

1. Stephen P. Robbins and Mary Coulter, “ Management”, Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCES:

1. Robert Kreitner and MamataMohapatra, “ Management”, Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011.
3. Tripathy PC and Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1999

RP5501	RUBBER COMPOUNDING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the technical classification of rubber mixes
- To impart role of chemical structure of fine chemicals on rubber compounding
- To introduce to the science of filler, short fibre, flexibilisers on formulations
- To study the quality related concepts
- To understand the compound design requirement of various rubber products

UNIT I SCIENCE OF COMPOUNDING 9

Technical approach to compound development,standardpractices,compounding for general and specific application, design of rubber compounds, processability, properties, performance and cost

UNIT II COMPONENTS 9

Compounding additives, cross linkers, age resistors, reinforcers, process enablers, extenders, flexibilisers, thermal aging resistors, special functional additives, homongenisers.Safe handling of various rubber chemicals - environmental regulations.

UNIT III COMPOUNDING FOR GENERAL PURPOSE RUBBERS 9

Hardness specified NR, SBR, compounds for age resistance, compression set resistance, flexural fatigue, abrasion resistance, vibration mounts and isolation pads, bridge bearing, conveyor belting.

UNIT IV COMPOUNDING FOR SPECIFIC END USES 9

Principles and materials for EPDM, CR, halobutyls, nitriles, silicones, fluorocarbons, chlorosulphonatedpolyethylenes, acrylates, polyurethanes, hydrogenated nitriles.

UNIT V QC ASPECTS 9

Application of QC, statistics on compounding, DOE, traceability, role of specific gravity on end use, sustainability, control and disposal of off spec compounds, matching of hardness.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to apply the concept of science in various addition, design a formulation for a specific requirement
- Apply basic statistics on compounding and the properties
- Appreciation for the choice of general purpose rubbers in a set of given conditions
- Theoretical background on the role of rubber chemistry and fine chemicals in solvent, thermal, oxidative environments
- Understand the costing aspects of compounds- volume, specific gravity and mass balance

TEXTBOOKS

1. The Mixing of Rubber (ed) by Richard F Grossman, Chapman & Hall, London, UK,1997,
2. "Rubber Technology - Compounding and Testing for Performance", John S Dick, Hanser Publishers, Munich, 2001.
3. Practical Rubber Compounding and Processing, Colin W Evans, Springer 1981.

REFERENCES

1. Bayer Handbook on Rubber Technology,
2. Vanderbilt Handook,
3. NOCIL manual,
4. Rubber Technology, Maurice Morton.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	2	2	2	1				3	3	3			3
CO2	3	3	3	2	2	2	1				3	3	3	3		3
CO3	3	3	3	2	2	2	1				3	3	3			3
CO4	3	3	3	2	2	2	1				3	3	3		3	3
CO5	3	3	3	2	2	2	1				3	3	3	3		3
Overall CO	3	3	3	2	2	2	1				3	3		3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5502 RUBBER PROCESSING AND PRODUCT MANUFACTURE L T P C
3 0 0 3

OBJECTIVES

- To impart the knowledge on various rubber processing machinery construction and its operations
- To understand the various rubber product manufacturing process
- To introduce the basic concept on plant layout and plant services for rubber product manufacturing

UNIT-I COMPOUNDING AND MIXING OPERATIONS 10

Rubber mixing mechanism, mixing machinery – construction and operations - Open mill mixing – Internal mixing – Energy mixing, Continuous mixing – Factors affecting mixing – Flow behavior of gum and rubber compound, processability test, Common problems in mixing.

UNIT-II FORMING OPERATIONS 10

Extrusion- construction and operations - Screw type – L/D ratio and its influence – Hot and cold feed extruders – Pin barrel extruder – Twin screw extruder –Factors affecting the extrusion process, Common problems in extrusions. Calendaring – construction and operations - Sheeting – Coating – Frictioning – Topping – Roll configurations – Control of thickness - Factors affecting the calendaring process, common problems in calendaring process.

UNIT-III MOULDING AND OTHER VULCANISING TECHNIQUES 10

Compression, transfer and injection moldingprocess – Blanks & pre-heating techniques, preparation of surfaces for bonding, common problems in molding. Vulcanization –Batch vulcanization- Autoclaves, Hot air chambers - curing of hand built up products - tank, pipe lining, roller covering. Continuous vulcanization - L.C.M. (Liquid Curing Media), Microwave curing, Roto cure, Hot air oven, common problems in curing.

UNIT-IV MANUFACTURE OF RUBBER PRODUCTS 10

Belting, Hoses, Cables, Rubber Footwear, Sportsgoods, molded products -Rubber to Metal bonded products- Bridge Bearings, Engine mountings, Finishing of rubber components.

UNIT-V PLANT DESIGN FOR RUBBER COMPONENTS MANUFACTURING 5

Plant layout design, Plant services, Power transmission, Hydraulics, Heating and cooling systems - automation, Safety systems, man power requirements, Storage and Flow pattern of materials, Energy conservation- Case study**.**

TOTAL : 45 PERIODS

OUTCOMES
Student should be able to:

- Acquire knowledge on various rubber processing machinery and its operation
- Familiarize with various rubber product manufacturing process
- Design a plant layout and familiarize with plant services for rubber product manufacturing

REFERENCES

1. Blow.C.M. andHepburn.C. Rubber Technology and manufacture, Butterworths, 1982.
2. Evans.C.W., Practical Rubber Compounding and processing, Applied Science Publishers, London, 1981.
3. Whelan.A., Injection Moulding Machines, Elsevier, 1989.
4. Stevens.M.J., Extruder Principles and Operations, Elsevier Applied Science, New York, 1985.
5. White.J.L., Rubber Processing Technology Materials, Principles, Hanser Publication, New York, 1995.
6. Richard F.Grossman,The Mixing of Rubber, Chapman & Hall,1997.
7. Kleemann, Weber, Elastomer Processing, Hansar, 2005.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	2	2	2	1				3	3	3		3	3
CO2	3	3	3	2	2	2	1				3	3	3	3	3	3
CO3	3	3	3	2	2	2	1				3	3	3			3
Overall CO	3	3	3	2	2	2	1				3	3	3	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5503 POLYMER COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

OBJECTIVES

To impart knowledge in:

- Fundamentals and types of composites
- Properties and applications of various thermoset resins.
- Various reinforcements and additives used in composite manufacture.

UNIT- I INTRODUCTION 6

Historical Development- Concept of Composite- Basic Definitions and Classifications of Composites - MMC, CMC and PMC- Advantages and Limitations of Composites Materials

UNIT- II MATRIX MATERIALS - THERMOSETS-I 10

PF, UF and MF Resins – Preparation properties and uses – Moulding powders – Additives Epoxy-Preparation properties and uses UnsaturatedPolyester, Vinyl Ester

UNIT-III MATRIX MATERIALS - THERMOSETS-II 9

Cyanate Ester, Furan resins, Polyimides and BMI's - preparation, properties and applications phthalonitrile resins, Benzoxazine resin – Preparation properties and applications

UNIT IV FIBROUS REINFORCEMENTS 9

Reinforcements-Classification-Role and Selection of fibers - Glass fibre -classification, Manufacture and properties, Carbon fibre -classification, Manufacture and properties, Aromatic polyamides ,PE fibres, Boron Fibres, Natural Fibres

UNIT – V ADDITIVES FOR COMPOSITES 8

Cross linkers, Coupling agents, Fillers -particulate, Whiskers, Nano fillers - carbons based, silica based, cellulose based, self reinforcing composites

TOTAL: 45 PERIODS

OUTCOMES:

- Students acquire fundamental knowledge on composites and its classification
- Students acquire knowledge about various matrix materials used
- Students acquire sound information onfibrous reinforcements
- Students understand the importance of additives in composite manufacture

REFERENCES

1. Weatherhead, R., "FRP Technology", Fibre Reinforced Resin Systems, Applied Science Publishers Ltd., London, 1990.
2. Krishan Kumar Chawla, "*Fibrous Materials",* Cambridge University Press, 1998
3. Michel Biron, " Thermosets and Composites: Technical Information for Plastics Users, Elsevier Advanced Technology, UK, 2004
4. Ken L. Forsdyke and Trevor F. Starr, "Thermoset Resins"Rapra Technology Limited, Shawbury, Shrewsbury, Shropshire, SY4 4NR, UK, 2002.
5.DebdattaRatna,"Handbook ofThermoset Resins",*i*Smithers – A Smithers Group Company, Shawbury, Shrewsbury, Shropshire, SY4 4NR, United Kingdom

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	2	2	2					3	3	3		3	3
CO2	3	3	3	2	2	2					3	3	3		3	3
CO3	3	3	3	2	2	2					3	3	3		3	3
CO4	3	3	3	2	2	2					3	3	3		3	3
CO5	3	3	3	2	2	2					3	3	3		3	3
Overall CO	3	3	3	2	2	2					3	3	3		3	3

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5504 PLASTICS PROCESSINGAND MACHINERY L T P C
3 0 0 3

OBJECTIVES

- To study the flow behaviour of plastics
- To understand various primary processing techniques
- To understand various secondary processing techniques

UNITI RHEOLOGY AND MELT PROCESSING OF PLASTICS 9

Flowbehavior – Flow analysis for Power law fluid - Viscosity and polymer processing, Melt flow index, capillary rheometer -thermal behaviour, crystallization, orientation.

UNITII EXTRUSION PROCESS & BLOW MOULDING 12

Extrudercomponentsandtheirfunctions–Geometry&varioustypesofextruderscrews-Barrierscrews,flowanalysiswithextruder,twostage,ventedextruders;– Plastics compounding and its machinery. Extrusion of pipes,profiles, films and sheets – Co extrusion - Blowmolding-Extrusionblowmolding–InjectionBlowmoulding–StretchBlowmoulding–Wall thickness and parison programming - Advanced blow moulding techniques - trouble shooting

UNITIII INJECTION MOULDING OF PLASTICS 12

Injectionunit,clampingunit–Specificationforaninjectionmouldingmachine - InjectionMachineratings– mould filling - mould cooling - components of an injection mould – Trouble shooting in injection moulding ofThermoplastics- advanced techniques - gas and water assisted injection moulding - structural foam moulding - multi colouredmoulding - process capability-total quality-SQC.

UNITIV MOULDING OF THERMOSETS 6

Thermosetting compounds-properties and uses; compression molding-preform and preheating-curing-process control; transfer molding-intergal and auxillarymould-process control-mould; thermoset injection moulding

UNITV THERMOFORMING, CALENDARINGAND ROTATIONAL MOULDING 6

Thermo Formingprocess–Vacuumforming,pressureforming,plug–assistedvacuumforming–Billowforming–Calendaringprocess –PVC sheeting process- Rotational molding – materials , process control and troubleshooting–Powdercoatingprocesses– Welding of plastics –Adhesive bonding of plastics – Machining of plastics– Laser marking – pad printing–painting- Sintering

TOTAL: 45 PERIODS

OUTCOMES

- Familiarize with various types of additives used for plastics and its mixing machinery.
- Acquaint of various parameters to operate injection molding machine.
- Realize the application of different types of injection molds.
- Gain knowledge of principle and process of extrusion, calendaring and blow molding operations.
- Aware of thermoforming, rotational molding and finishing, machining and welding of plastics.

REFERENCES:

1. HaroldBelofsky, "Plasticsproductdesignandprocessengineering"Hanserpublishers, 1995
2. TinA. Osswald, "Polymer Processing Fundamentals ", Hanser publishers, 1998.
3. Walter – Michaeli, "Plastics ProcessingAn Introduction", Hanser, 1995.
4. RubinI."Hand book of Plastics Materials &Technology," Wiley, Interscience, 1999.
5. CrawfordR.J, "Plastics Engineering," 3 rdEdition, Elsevier publications, 2005

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	3	2	3		1	1			2	2	3			
CO2	3	3	3	2	3		2	2	3	2		3		3	2	3
CO3	3	1	3		2	2			2		2		2	1	2	3
CO4	3	2	2	3	2			2	2	3			2	1	1	3
CO5	2	2	1	1	2	1			2	3	2		3	2	2	3
Overall CO	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**3**	**2**	**2**	**3**

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP 5511 **RUBBER PROCESSING LAB** **L T P C**
0 0 4 2

OBJECTIVES

To make the student to familiarize with

- Mixing studies of various rubbers
- Processing and curing studies of various rubbers.
- Preparation of samples for different testing of rubbers and its hands on experience.

The students will prepare using the rubber & rubber materials as appropriate using the process machinery as suggested in the following titles

Ex No:1 Mixing behaviour of NR on two roll mill
Ex No :2 Mixing study of carbon black filled NR
Ex No: 3 Mixing study of carbon black filled SBR
Ex No: 4 Mixing study of carbon black filled SBR & NR blend
Ex No: 5 Mixing study of carbon black filled EPDM
Ex No: 6 Mixing study of carbon black filled NBR
Ex No: 7 Extrusion characteristics of a filled rubber mix- NR
Ex No: 8 Extrusion characteristics of a filled rubber mix- SBR
Ex No: 9 Extrusion characteristics of a filled rubber mix- NBR
Ex No: 10 Extrusion characteristics of a filled rubber mix- EPDM
Ex No: 11 Curing Process of Rubber Compound- NR filled
Ex No: 12 Curing Process of Rubber Compound- SBR filled
Ex No 13 Curing Process of Rubber Compound- NBR filled
Ex no: 14 Curing Process of Rubber Compound- EPDM filled

TOTAL: 60 PERIODS

OUTCOMES:

- Operate and mix rubber compound using 2-roll mixing mill.
- Optimize the cure parameters of various rubber compounds.
- Mold rubber compounds using molds such as tensile, flex, buttons.
- Demonstration of the skill acquired to operate and analyze the problems in various rubbers processing equipment.
- Capability to carry out testing of rubber compounds and observe the behavior of the material under the test conditions.
- To perform the cure characteristics and mechanical testing of rubbers.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	1	1	1	1	-	-	-	1	1	1	-	-	-
CO2	2	3	3	3	2	2	1	-	-	-	2	3	3	2	-	1
CO3	1	3	3	3	2	2	1	-	-	-	1	-	1	1	1	1
CO4	2	2	3	3	2	2	-	-	-	-	1	2	2	2	1	1
CO5	1	3	2	3	3	1	1	-	-	-	1	2	1	2	2	1
Overall CO	1	3	3	3	2	2	1	-	-	-	1	2	2	1	1	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5512 RUBBER AND PLASTICS TESTING LABORATORY L T P C

0 0 4 2

OBJECTIVES

- Provide the hands on experience in various rubber and plastics testing instruments,
- Know the sample preparation Techniques
- Test the Compound and vulcanizate properties.

RUBBER TESTING EXPERIMENTS

RUBBER COMPOUND TESTING

1. Determination of Mooney Viscosity of Raw and Compounded rubber
2. Determination of Scorch and Cure parameters of Compounded rubber

RUBBER VULCANIZATE TESTING

1. Hardness, Resilience,
2. Tensile properties,Tear strength,
3. Fatigue (crack initiation and propagation)
4. Abrasion resistance , Compression Set Resistance
5. Hot air aging Resistance, Swelling Resistance

PLASTICS TESTING EXPERIMENTS

1. Tensile Testing of Plastics
2. Flexural Testing of Plastics, Compressive Testing of Plastics
3. Impact Testing of Plastics, Falling Dart Impact testing for films
4. Arc Testing of Plastics
5. Melt flow index, Bulk Density
6. HDT & VSP

7. COF, 11. ESCR

TOTAL: 60 PERIODS

COURSE OUTCOMES:

- To prepare and characterize the product for testing
- Understand the importance of standards and specifications.
- Familiarization about various test methods on Rubber and Plastics used in industry.
- Access and analyze the properties and performance of the rubber and plastics products in service condition.

TEXT BOOKS:

1. Vishu Shah, Hand Book of Plastics Testing Technology, John Wiley & Sons. Inc.New York, 1998.
2. R.P. Brown, Hand Book of Plastics Test Methods, George Godwin Ltd., London,1981

REFERENCES:

1. ASTM test standards for plastics Vol.8.01 to 8.04, 9.01 & 9.02, 2002.
2. ISO test standards, 1998.

Course Outcome	Program outcome and Program Specific Outcome															
	PO 1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	3	2	3		3		2		2	2		1	2	3	1	2
CO2	3	2	2	3			1	1		2		2	2	2		2
CO3	2		3	2	3		1	1					2	1		3
CO4	3	3	3	3	2		1						3	3	2	2
Overall CO	**3**	**2**	**3**	**3**	**3**		**2**	**1**	**2**	**2**		**2**	**2**	**3**	**2**	**2**

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP 5601 PLASTICS PRODUCT DESIGN L T P C
3 0 0 3

OBJECTIVES

To impart knowledge

- on fundamentals of product design
- on plastics product design
- on composite product design
- on latest tooling concepts

UNIT I INTRODUCTION TO PLASTICS PRODUCT DESIGN 9

Product design, steps for product design, factors affecting product design - size, shape and function - form and function - Aesthetics, Ergonomics - shrinkage, Flash lines. Undercuts - External & Internal - Wall thickness - variances in wall thickness - Emphasize on designing with engineering plastics. Taper / draft - Fits & Tolerances.

UNIT II PLASTICS PRODUCT DESIGN I 9

Designing with plastics for load bearing applications like gears, bearing, sandwich laminates. Design of radii, fillets, ribs and bosses. Design for flow and shape. Moulded Holes - through holes - blind holes - threaded holes - side holes - holes parallel to draw - nearness of holes to each other and side wall - moulding holes not parallel to draw - drilled and tapped holes.

UNIT III PLASTICS PRODUCT DESIGN II 9

Design of integral hinges, hinges and snap fits for boxes and assembly of moulded parts. Moulded threads—thread pieces—threaded holes. Inserts-Materials-Selection of metal for inserts-minimum wall thickness of material round inserts-relieving moulding stresses around inserts-location of inserts in the part- moulded in inserts-pressed in inserts

UNIT IV TOOLING ASPECTS 9

Quality and economy-tooling aspects on product design-process variables and product design-product design appraisal. Product design limitations-shrinkage and tolerance-minimum wall thickness mechanical properties-creep properties-end use requirements with case studies. Prototype development – rapid prototyping techniques – stereolithography.

UNIT V COMPOSITES PRODUCT DESIGN 9

Design requirements- functional-safety-reliability –cost effectiveness- Design constraints-factor of safety for uncertainties -design failure criteria- optimization in design. Design for physical, mechanical and functional properties of composites-code of practice of loading on structures- Design of simple structural elements-tension bars-columns-beams-pipes-plates and shells. Design of joints-bolted, joints-bonded joints.

TOTAL: 45 PERIODS

OUTCOMES

1.Students will acquire the knowledge and principles of basic plastics product design.
2.To enable the students to understand the concepts of plastics and composite product design.
3.To learn the design for threaded moulds and insert moulded products.
4.To acquire knowledge on tooling aspects.

TEXTBOOKS

1. Robert A. Malloy, “Plastic Part Design for Injection Moulding”, Hanser Publishers, Munich Vienna, New York, 1994..
2. Paul A. Tres, “Designing Plastic Parts for Assembly”, 2nd Revised Edition, Hanser Publishers, Munich Vienna New York, 1994.

REFERENCES

1. N G Mc Crum, Principles of Polymer Engineering, Oxford Science Publications, New York, 1997.
2. Belofsky, H., “Plastics Product Design and Processing Engineering, Hanser Publishers, Munich Vienna New York, 1994.
3. Plastics Product Design Engineering Hand Book- By Dubois, H.
4. Plastics Product Design & Process Engineering -By Belofsky, Harold

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1		3	3	3	3	2						3	3	1	3	3
CO2		3	3	3	3	2						3	3	1	3	3
CO3		3	3	3	3	2						3	3	1	3	3
CO4		3	3	3	3	2						3	3	1	3	3
Overall CO		3	3	3	3	2						3	3	1	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP 5602 RUBBER PRODUCT DESIGN L T P C
3 0 0 3

OBJECTIVES

- To study the design fundamentals for structural and product designs.
- To enhance the knowledge on designing of rubber components.
- To appreciate the role of rubber in noise and vibration control.
- To relate viscoelasticity of rubber in load bearing and space filling applications.

UNIT I DEFORMATION, LOADING AND RESPONSE 9

Spring rates- creep- stress relaxation- rubber in compression- simple geometries- blocks- geometry and materials on spring characteristics- metal bonded rubber assemblies- design for spring rates.

UNIT II DESIGN FOR COMBINED DEFORMATION 9

Rubber product in simple shear- axial shear- rotary shear- sleeves- bush for torsion loads- shear spring rates- compression and shear in combination- material selection.

UNIT III RUBBER DESIGN FOR DAMPING AND DYNAMIC CONDITION 9

Dynamic mechanical properties and media- hysteresis- heat generation- vibration control- damping- engine mounts, bearings and earthquake resistant bearings- compound design.

UNIT IV SEALS AND SEALABILITY OF RUBBER AND PRODUCT DESIGN 9

Rubber in fluid sealing - type of seals- static seals, gaskets- couplings, hose- profile- beltings- conveyor and power transmission- failure mechanism and remedial measures.

UNIT V MOULD DESIGN FOR RUBBER PRODUCTS 9

Moulds for rubber products- compression molds- transfer molds- injection molds- rubber products for specialty applications- nuclear- aerospace- naval fields.

TOTAL: 45 PERIODS

OUTCOMES

- Demonstrate the role of rubber elasticity in product application
- To understand rubber application in load bearing, sealing and vibration control
- The student gets some idea about design aspects of materials and product geometry.
- Compare the role of rubber hardness and form factor in fatigue life and strength of products.

REFERENCES

1. Alan N Gent, “Engineering with Rubber”, Hanser Verlag, Munich, 2001.
2. FreakleyP R and PayneA R, “Theory and Practice of Engineering with Rubber,” Applied Science Publishers, London, 1970.
3. LindleyP B, “Engineering Design with Natural Rubber”, RAPRA, London, 1974.
4. GobelE F &BrichtaA M, Newnes, “Rubber Springs Design,”Butterworths, London 1974.
5. A D Roberts, “Natural Rubber Science and Technology”, OUP, London, 1998

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1		3	3	3	3	2						3	3	1	3	3
CO2		3	3	3	3	2						3	3	1	3	3
CO3		3	3	3	3	2						3	3	1	3	3
CO4		3	3	3	3	2						3	3	1	3	3
Overall CO		3	3	3	3	2						3	3	1	3	3

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5603 COMPOSITES TECHNOLOGY L T P C
2 0 2 3

OBJECTIVES

- To understand the basic and advanced composite processing techniques
- To Identify, describe and evaluate the properties of fibre reinforcements, polymer matrix materials and commercial composites.
- To analyze the elastic properties and simulate the mechanical performance of composite laminates
- To understand and predict the failure behavior of fibre-reinforced composites
- To perform various tests on composites

UNIT I MECHANICS OF COMPOSITES 9

Mechanical advantage – Micro & Macro Mechanics of composites - Laminated structures – stress-strain relationships - fiber-matrix Interactions in a unidirectional lamina – Longitudinal and transverse loading – Halpin-Tsai equations – Minimum & Critical volume fraction – Deformation behavior of single ply – loading on fiber Axis – loading off the fiber axis - Analysis of short fiber composites – load transfer length

UNIT II DESIGN OF COMPOSITES 9

Design criteria – Design Allowable – design procedure with composites – Failure predictions of unidirectional lamina – Notched lamina – hole size effect – De-lamination initiation – Finite element analysis in composites – Joint design – Design of tension, compression & torsion member – Design of sandwich beam.

UNIT III FABRICATION 12

Hand Layup and Spray up Techniques - Resin Transfer Molding – Reaction Injection Molding -Vacuum Infusion – SMC& BMC - Pressure Injection - Compression Molding- Composite Tooling - Automated tape laying technique & fiber placement - Filament winding – Pultrusion - Thermoplastic Composite manufacturing - Processing of carbon-carbon composites. Post processing - Secondary Adhesive bonding - Joining of Thermoplastic Composites - Composite Repairing - Hole drilling - Environmental protection and sealing - Composite repairing.

UNIT IV TESTING OF COMPOSITES 9

General mechanical properties – Tension, compression, flexural & shear – Inter-laminar shear strength- fatigue- impact- fracture behavior and damage tolerance – non mechanical test – per ply thickness – constituent content – density – CTE – Thermal conductivity – Diffusivity – Pin bearing strength – non destructive Testing.

UNIT V COMPOSITES FOR SPECIFIC APPLICATIONS 6

Aircraft radomes - Composite leaf-spring – composite pressure vessel – tubes for space stations truss structure – Boat hull – automotive shaft – Chemical transportation pipe - solid rocket motors- windmill blades – Orthopedic applications – Application in Dentistry.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Acquire the knowledge of various techniques involved in manufacturing of composites
- Apply basic principles of mechanics to composite materials
- Select raw materials for a lamina, chose the proper stacking sequence of laminas, and design a laminated composite structure to best suit specific applications
- Predict the failure of laminate based on various failure theories.
- Apply knowledge of composite mechanical performance and manufacturing methods to a composites in design/main project

REFERENCES:

- 1. Weatherhead, R.G., "FRP Technology", Applied science Publishers Ltd., 2000.
- 2. Xiao-SuYi, Shanyi Du., "Composite Materials Engineering" Vol.1&2. Springer.
- 3. Mortensen. A., "Concise Encyclopedia of Composite Materials" Elsevier.
- 4. ASM Handbook, Vol. 21.
- 5. Krishan K. Chawla., "Composite Materials Science and Engineering" Springer. 1998.
- 6. Crawford RJ., " Plastics Engineering" Elsevier. 2011.
- 7. Mallick P.K., "Fiber reinforced Composites" Marcel Dekker Inc.1993.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3		3	3	2	2			2	3	2	3	3
CO2	3	3	3	3		3	3					2	3	2	3	3
CO3	3	3	3	3		3	3					2	3	2	3	3
CO4	3	3	3	3		3	3					2	3	2	3	3
CO5	3	3	3	3		3	3					2	3	2	3	3
Overall CO	3	3	3	3		3	3	2	2			2	3	2	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5611 PRODUCT ANDMOULD DESIGN LABORATORY L T P C
0 0 4 2

OBJECTIVE

- To provide hands on experience in designing and drawing of moulds and dies for plastics and rubber products.
- To impart the knowledge in designing of extrusion dies.
- To train the students to analyze the flow behavior of plastics materials for specific products by mould flow analysis software's.

LIST OF EXPERIMENTS

I DESIGN AND DRAWING OF MOULDS

1. Hand Mould
2. Semi – Injection Mould
3. Automatic Mould – with working area calculations
4. Multi Cavity – Multiday Light Mould
5. Split Cavity – Finger Cam Mechanism
6. Split Cavity – Dog Leg Cam Mechanism
7. Split Cavity – Cam tract Actuation
8. Side Core – Hydraulic Actuation
9. Collapsible core – Mechanism
10. Gear Core – Mechanism
11. Compression Mould
12. Transfer Mould

II DESIGN AND DRAWING OF EXTRUSION DIES

1) Hot and Cold Extrusions
2) Extrusion of Tubes and profiles

II. ANALYSIS OF INJECTION MOULDING OF SIMPLE PRODUCTS USING MOULD FLOW ANAYSIS SOFTWARES

Product mould design considerations – Mould filling and cooling analysis – Control of product tolerances – Increasing product strength and stiffness – Designing for assemblies- Design for assembly and service.

TOTAL: 60 PERIODS

OUTCOMES

Upon completion of this course, the students can able to

- understand mould and die design and drawing.
- design a mould for complex plastics product with allowances
- design a gate system, ejection system, and cooling system for particular mould
- analyze the flow behaviour of plastics in every stages of forming such as filling, packing, cooling, warping etc.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3	3	-	-	-	-	-	-	-	2	1	-	1
CO2	3	3	2	3	3	-	-	-	-	-	-	-	3	3	-	1
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-	1
CO4	3	3	2	3	3	-	-	-	-	-	-	-	3	3	-	1
Overall CO	3	3	2	3	3	-	-	-	-	-	-	-	3	3	-	1

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5612 PLASTICS PROCESSING LAB L T P C
0 0 4 2

OBJECTIVE

- To provide hands on experience in various plastics processing equipments.

LIST OF EXPERIMENTS

1. Compounding and Mixing of plastic and their characteristics.
2. Semi and Fully Automatic Injection Molding-Piston Type.
3. Injection moulding
4. Extrusion of plastics-Single screw and Twin screw extruder
5. Compression moulding
6. Composites-Hand lay-up technique Gelation
7. Study of Injection and Compression molds.
8. Study of machining of plastics
9. Study of Adhesive materials
10. Determination of gel point

TOTAL: 60 PERIODS

COURSE OUTCOMES

- Apply practical skills in handling various plastic processing equipments
- Able to identify the different processing defects
- Able to troubleshoot the processing problems.

TEXT BOOKS

1.Development in Injection Molding - By Whelan, A & Craft, J.L.
2.Technician's Hand Book & Plastics - By Grandilli, P.A.,1981.

REFERENCES

1.Plastics Materials & Processing - By Schwartz & Goodman.,1982.
2.Innovation in Polymer Processing - By Stevenson.,1996

Course Outcome	Program outcome and Program Specific Outcome															
	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1			3	3	3	2	2						2	2	3	3
CO2			3	3	3	2	2						2	2	3	3
CO3			3	3	3	2	2						2	2	3	3
Overall CO			3	3	3	2	2						2	2	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP 5701 TECHNOLOGY OF TYRES AND TUBES L T P C
3 0 0 3

OBJECTIVES

- To impart the relationship between rubberiness and tyre functions
- To impart the knowledge on geometry, components and their materials.
- To impart the indispensability of pneumatic tyre in handling, performance
- To impart tyre manufacturing, process flow and inspection.
- To impart the role of material science on the emerging tyre requirements.

UNIT I TYRE FUNCTIONS 9

Functions of pneumatic tyres, tyre geometry, tyre sizes, nomenclature,role of inflation pressure, deflection, generic designs, comparison of diagonal and radial construction.

UNIT II TYRE MECHANICS 9

Tyre load, ply rating, tubeless construction, tyre components- primary and secondary, role of dimensions on carcass and bead stress, tyre forces, spring rates and moments.

UNIT III TYRE DESIGN 9

Tyre composites- textile and steel cord- materials and methods, adhesion techniques, measurement, fatigue and endurance, role of cord angle in diagonal and radial, shear relationship.

UNIT IV TYRE PERFORMANCE 9

Tyre performance- role of components and construction, cornering, traction, tyre handling, rolling resistance, tread design, abrasion resistance, wet grip.

UNIT V TYRE MANUFACTURE AND TESTING 9

Tyre and tube manufacturing, Tyre testing and failure analysis, disposal of end of life cycle, tyre retreading, regulations, smart tyres, run flat tyres, TPMS

TOTAL: 45 PERIODS

OUTCOMES

Students will have acquired knowledge in the following:

- Basics of tyre terminology and construction
- Various forces experiences by the tyre
- Various components of making a tyre and their functions
- Important performance properties of tyre and their optimization
- Key Technologies involved in tyre manufacture and tyre recycling

REFERENCES

1. Clark S K, `Mechanics of Pneumatic Tyres' US Department of Transportation, 1981.
2. Gent A N, Walter J D, `The Pneumatic Tyre' published by NHTSA, DOT, USA, 2005.
3. Setright J K., `Automobile Tyre' Chapman and Hall, 1972.
4. Kovac Frederick J., `Technology Forecasting Tyres'The Goodyear Tire Company, 1973.
5. Wake W C., and Wootton D B., `Textile Reinforcement of Elastomers' Springer, The Netherlands, 2012.

Course Outcome	Program outcome and Program Specific Outcome															
	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1		3	3	3	3	2	2					3	3	3	3	3
CO2		3	3	3	3	2	2					3	3		3	3
CO3		3	3	3	3	2	2					3	3	3	3	3
CO4		3	3	3	3	2	2					3	3	3	3	3
CO5		3	3	3	3	2	2					3	3	3	3	3
Overall CO		3	3	3	3	2	2					3	3	3	3	3

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5711 **COMPREHENSION**

L T P C
0 0 4 2

In the VII Semester a comprehension test will be conducted with at least one written test in the middle of the Semester with Objective type of questions and a terminal viva-voce test in order to evaluate the comprehension of the students in all the subjects covered in the earlier semesters.

TOTAL: 60 PERIODS

OUTCOMES

CO1 Comprehend the courses studied
CO2 Make the students technically stronger
CO3 Prepare the students to face the interview

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3									3	3	3	3	
CO2	3	3	3									3	3	3	3	
CO3	3	3	3							3		3	3	3	3	
Overall CO	3	3	3							3		3	3	3	3	

RP 5712 PROJECT - I

L	T	P	C
0	0	6	3

The students are expected to carryout one design project in the following fields of Rubber/Plastics Technology:

1. Computer aided Drafting and Design
2. Product Development and Analysis
3. Development of Machines for Rubber Processing
4. Development of machines / apparatus for rubber / plastics testing.
5. Mould / Die Design
6. Process Control / Modification
7. Plant Layout

TOTAL: 90 PERIODS

OUTCOMES

CO1: Perform extensive literature survey on proposed research area
CO2: Identify the research gap and formulate the objectives
CO3: Evaluate the results and prepare the final report

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	3	2	3	2	3	2	3	2	2	3	3	3	3	2
CO2	1	3	3	2	3	2	3	2	3	2	2	3	3	3	3	2
CO3	1	3	3	2	3	2	3	2	3	2	2	3	3	3	3	2
Overall CO	1	3	3	2	3	2	3	2	3	2	2	3	3	3	3	2

RP 5811 **INDUSTRIAL TRAINING** **L T P C**
0 0 - 2

All the students have to undergo industrial training of **FOUR weeks** duration in recognized establishments, at the end of which they have to submit a report. The internal assessment will be based on the report and presentation and the examination marks, on viva voce examination.

OUTCOMES

CO 1 Get hands-on experience on various machineries

CO 2 Apply the knowledge gained from theory courses

CO 3 Apply the experience gained from various laboratory courses

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3	3	1	3	2	3	2	3	2	2	3	2	2	2	2
CO2		3	3	1	3	2	3	2	3	2	2	3	2	2	2	2
CO3		3	3	1	3	2	3	2	3	2	2	3	2	2	2	2
Overall CO		3	3	1	3	2	3	2	3	2	2	3	3	3	3	2

RP 5812 **PROJECT – II** **L T P C**
0 0 16 8

Each student will be assigned a project involving some design and fabrication work as well as theoretical and experimental studies on problems related to Rubber and Plastics Technology. Continuous internal assessment marks for the project will be given during project review meeting. The student has to prepare and present a detailed project report at the end of the semester and give a presentation about the work done. End semester examination mark will be based on viva voce examination.

TOTAL:240 PERIODS

OUTCOMES

CO 1 Able to identify research gap

CO 2 Able to propose the objectives

CO 3 Able to design and develop process and products

CO 4 Able to apply the knowledge gained from various theory and Lab courses

CO5 Triggers the confidence to become entrepreneurs

Course Outcome	**Program outcome and Program Specific Outcome**															
	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	1	3	3	2	3	2	3	2	3	2	2	3	3	3	3	2
CO2	1	3	3	2	3	2	3	2	3	2	2	3	3	3	3	2
CO3	1	3	3	2	3	2	3	2	3	2	2	3	3	3	3	2
CO4	1	3	3	2	3	2	3	2	3	2	2	3	3	3	3	2
CO5	1	3	3	2	3	2	3	2	3	2	2	3	3	3	3	3
Overall CO	1	3	3	2	3	2	3	2	3	2	2	3	3	3	3	2.2

LIST OF ELECTIVES

MA5353 NUMERICAL METHODS L T P C
3 1 0 4

OBJECTIVE

- To introduce the importance of numerical concepts in solving the problems.

UNIT I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 12

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton-Raphson method – Solution of linear system of equations – Gauss Elimination method – Pivoting – Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel – Matrix Inversion by Gauss-Jordan method – Eigen values of a matrix by Power method and by Jacobi's method.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals – Lagrange interpolation – Newton's divided difference interpolation – Cubic Splines – Interpolation with equal intervals – Newton's forward and backward difference formulae – Linear curve fitting – Least square method.

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method – Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step-methods – Taylor's series method – Euler's method – Modified Euler's method – Fourth order Range-Kutta method for solving first and second order equations – Multi-step methods – Milne's and Adams-Bashforth predicator-corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL:60 PERIODS

TEXT BOOKS:

1. Grewal, B.S. and Grewal,J.S., "Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 9th Edition, 2011.
2. Sankara Rao. K.,"Numerical methods for Scientists and Engineers", Prentice Hall of India Private Ltd., New Delhi, 3rd Edition, 2007.

REFERENCES:

1. Aurene V. Fausett, "Applied Numerical Analysis using MATLAB", Pearson Education,New Delhi, 1st print, 2nd Edition, 2009.
2. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education Asia, New Delhi, 1st Edition, 2007.
3. Gerald, C.F. and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 6th Edition, 2006.

LT5071	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVE

This course aims to provide necessary knowledge and attitude to understand and appreciate the process of starting and developing a new venture.

UNIT I QUALITY OF ENTREPRENEURS 8

Entrepreneurs – Mindset, character, motivation. Competencies - creativity, innovation, risk taking, leadership, communication. Negotiation and networking skill. Myths about entrepreneurs; benefits and drawbacks of entrepreneurship. Reasons for a venture failure. Successful first generation entrepreneurs in leather sectors – case study.

UNIT II PLANNING AND DEVELOPMENT 8

Business Plan - Generating idea; converting an idea into business venture. Conducting feasibility analysis – Financial, Commercial, Technical, Environmental and Legal. Developing a business plan for leather and leathers products. Presenting a business plan to investors to pitch for funds.

UNIT III FINANCIAL MANAGEMENT 10

Business Finance – Forms of ownership, Financial projections and pro- forma of profit and loss account, cash flow statements; production and marketing budgets. Capital budgeting and investment analysis, breakeven point and sensitivity analysis to decide on a tannery proposal. Source of funds – own funds, banks, long term development financial institutions, Angel investors, Venture Capitalist, Public issue (IPO). Taxes - VAT, Service Taxes, Excise and Customs duties, CST, GST (proposed), tax exemptions for exports and SEZ. Controlling business - working capital control and cost control; inventory, procurement and receivables control. Quality control. Sales and marketing expenses control. SCM for leather sector.

UNIT IV ORGANIZATIONAL MANAGEMENT 9

Building Team – creating growth oriented organizational culture. Employee motivation, retention strategies. Organizational structure with clear roles, responsibilities, authorities and accountabilities. Attracting talent with ESOP and other incentives and benefits. Training development to enhance the quality of operators, supervisors and managers of the tannery.

UNIT V BUSINESS DEVELOPMENT STRATEGIES 10

Building Business – Market plan, market research, competitive analysis, formulating competitive marketing strategy – Segmenting, Targeting and Positioning of the brand. Formulating marketing mix – 4 P. Personal selling, managing a sales team. Distribution and CRM Strategy. New Product development. E-commerce fundamentals; strategy for expansion. Franchising - benefits and drawbacks of franchising. Global marketing – overseas marketing strategies; export documentation. Mergers and Acquisitions – synergy and valuation. Intellectual Property - patterns, trademarks, copy rights and trade secrets to grow the business in leather sector.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of this course, the students are expected to

CO1. Have knowledge on entrepreneurial tasks such as, generating idea, planning business
CO2. Have knowledge on financial management
CO3. Understand the organizational management and business development strategies.

REFERENCES:

1. Entrepreneurship - D.F. Kuratko and T.V.Rao – Cengage Learning -2012 ; ISBN – 978-81315-1716-1
2. Entrepreneurial Development – Dr. S.S. Khanna - S. Chand -2012 ISBN – 81- 219-1801-4
3. Handbook for New Entrepreneurs – P.C. Jain – Entrepreneurship Development Institute of India – 2010; ISBN:13 : 978-0-19-565224-6
4. Essentials of Entrepreneurship and Small Business Management – Thomas W. Zimmerer, Norman M. Scarborough – PHI Learning Ltd New Delhi. ISBN : 978 – 81- 203-3911-8
5. http://smallb.in/entrepreneurship - A SIDBI initiative
6. http://business.gov.in/ - Business Knowledge Resources for SMEs
7. http://www.dcmsme.gov.in/ - Development Commissionaire (MSME) Ministry of Small Micro Medium Industries

Course Articulation Matrix:

Course Outcomes	Statement	Program Outcome															
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	Have knowledge on entrepreneurial tasks such as, generating idea, planning business	-	-	2	3	3	3	-	3	-	-	-	3	-	3	3	3
CO2	Have knowledge on financial management	-	-	2	3	3	3	-	3	-	-	-	3	-	3	3	3
CO3	Understand the organizational management and business development strategies.	-	-	2	3	3	3	-	3	-	-	-	3	-	3	3	3
ENTREPRENEURSHIP DEVELOPMENT		-	-	2	3	3	3	-	3	-	-	-	3	-	3	3	3

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

GE5074 FUNDAMENTALS OF NANOSCIENCE LTPC 3003

UNIT I INTRODUCTION 8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, 92 Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO_2,MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dotspreparation, properties and applications

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nano-indentation

UNIT V APPLICATIONS 7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TOTAL: 45 PERIODS

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, “Nanoscalecharecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES:

1. G Timp (Editor), “Nanotechnology”, AIP press/Springer, 1999.

2. AkhleshLakhtakia (Editor),“The Hand Book of Nano Technology,Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007

GE5552 **ENGINEERING MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES: The main learning objective of this course is to prepare the students for:

1. Explaining basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. Applying various functions of management in professional organization.
3. Applying organizational theory in professional organization.
4. Applying the principles of productivity and operations management in professional organization.
5. Applying modern concepts and marketing in management in professional organization.

UNIT I INTRODUCTION TO MANAGEMENT 9

Definition and functions of Management - Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Corporate Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Pros and cons.

UNIT II FUNCTIONS OF MANAGEMENT 9

Planning: Characteristics; Nature; Importance; Steps; Limitation – Organizing: Features; Process; Principles; Types – Departmentalization: Functional – Divisional (Product; Customer; Geographic) – Staffing: Systems Approach; Recruiting and Selection Process – Directing (Leading): Traits; Style; Managerial Grid (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Types; Audit (External, Internal, Merits) – Decision Making: Elements; Characteristics; Process; Classification – Controlling techniques.

UNIT III ORGANIZATION THEORY 9

Human Resource Development (HRD): Goals – Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Need and Motivation Theories: Maslow's Hierarchy of Needs Theory; Herzberg's Motivation-Hygiene Theory; McClelland's Needs Theory of Motivation – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT IV PRODUCTIVITY AND OPERATIONS MANAGEMENT 9

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Operations Management Tools: (Simple problems in) Transportation Model (Balanced); Assignment Model (Hungarian); Network Model (Shortest path); Critical Path Method; Decision Trees.

UNIT V MODERN CONCEPTS AND MARKETING MANAGEMENT 9

Concept, features, merits and demerits of: SWOT Analysis; Business Process Re-engineering (BPR); Supply Chain Management (SCM) – Marketing: Concept; Functions; Importance; Segmentation; Mix; Problems of Marketing in Small Enterprise; Competitive Analysis and Advantage – E-marketing.

Total (L: 45) = 45 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. Apply various functions of management in professional organization.
3. Apply organizational theory in professional organization.
4. Apply the principles of productivity and operations management in professional organization.
5. Apply modern concepts and marketing in management in professional organization.

TEXT BOOKS:

1. Koontz. H. and Weihrich. H., Essentials of Management: An International Perspective, 8th Edition, Tata McGrawhill, New Delhi, 2010.
2. M. Govindarajan and S. Natarajan, Principles of Management, Prentice Hall of India, New Delhi, 2009.

REFERENCES:

1. Joseph J, Massie, 'Essentials of Management' Prentice Hall of India Pvt. Ltd., 1985.
2. M. Govindarajan, Marketing Management, Prentice Hall of India, New Delhi, 2010.
3. R. Panneerselvam, Operations Research, Prentice Hall of India, New Delhi, 2013.
4. S.Chandran, Organizational Behaviours, Vikas Publishing House Pvt. Ltd., 1994.
5. Saxena, P.K., Principles of Management: A Modern Approach, Global India Publications, 2009.

GE5451 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

UNIT- I INTRODUCTION 8

Definition and dimensions of quality – Historical Review – Quality Control and Quality Assurance – Total Quality Management: Definition, benefits – Six basic concepts of TQM – Teaching of Quality Gurus – Obstacles for TQM implementation.

UNIT- II TQM – OLD TOOLS 8

Pareto Diagram – Process Flow Diagram – Cause –and-Effect Diagram – Check sheets – Histogram – Control Charts for variables – Control Charts for attributes – Process Capability – Scatter Diagram.

UNIT- III TQM – MANAGEMENT TOOLS 8

Why Why Analysis – Forced Field Analysis – NG Technique – Affinity Diagram – Interrelationship Diagram – Tree Diagram – Matrix Diagram – Prioritisation Matrices – Process Decision Program Chart – Activity Network Diagram.

UNIT- IV TQM – PRINCIPLES 10

Leadership – Role of Senior Management – Customer Satisfaction – Customer Retention – Employee involvement – Juran Trilogy – PDSA Cycle – Kaizen – Supplier Partnership – Supplier certification and Rating – Malcolm Baldrige National Quality Award – 5S Principles – Poka Yoke.

UNIT- V TQM TECHNIQUES 11

Quality circles and their application – Bench Marking – Reasons and Procedure for Bench Marking – Quality Function Deployment (QFD): Procedure and benefits – Total Productive Maintenance (TPM) – Failure Mode and Effects Analysis (FMEA): Procedure and applications – Design of Experiments – Taguchi's Quality Engineering: Principles and applications – ISO System: Procedure and applications.

TOTAL: 45 PERIODS

Text Book:

1. Dale H. Besterfield, et al., "Total Quality Management", Pearson Education, inc. 2003 (Indian reprint 2004) ISBN 81-297-0260-6.

Reference

1. Zeiri, "Total Quality Management for Engineering Wood Head Publishers, 1991.
2. James R. Evans & William M. Lidsay, " The Management and Control of Quality, (5th Edition), South-Western (Thomson Learning), 2002 (ISBN 0324 – 06680-5).
3. Feigenbaum A.V. "Total Quality Management", McGraw Hill, 1991.
4. Oakland J.S., "Total Quality Management", Butterworth-Heinemann Ltd., Oxford, 1999.

GE5551 STATISTICS FOR PRODUCTION MANAGEMENT L P T C
3 0 0 3

OBJECTIVES:

- To train the students so that students will be able to design experimental designs and use these concepts for research design.
- To introduce the concept of probability so that they can be used for industrial applications.
- To stress upon the importance of the sampling theory and its usefulness in industrial quality control.
- To make students familiarize with the concepts of estimation theory and its applications.
- To help students the usefulness of test of significance and its applications in industry and research.

UNIT I PROBABILITY THEORY 12

Random variables – Discrete and continuous random variable- Probability mass and density functions- Joint density and mass functions-Moment about mean and origin- Moment generating and characteristic functions – Binomial, Poisson, Normal distributions and their applications- to manufacturing problems.

UNIT II SAMPLING THEORY 12

Sampling with and without replacement- Random sample- Sampling distributions of means, proportions, difference of means and proportions-Student 't' distribution- Chi square distribution- Fisher's distribution and their applications to production problems.

UNIT III ESTIMATION THEORY 6

Point and Interval estimation- Confidence limits for mean, proportions, difference of means, proportions- Confidence limits using student 't' distribution, Chi square and F distribution-applications.

UNIT IV TESTING OF HYPOTHESIS 10

Procedure for testing hypothesis and significance- Level of Significance of large samples for means, proportions, difference of means and difference of proportions- Tests based on student t distribution, chi square distribution and F distribution – Applications to manufacturing.

UNIT V ANOVA 5

One factor experiments – Mathematical model for one factor experiments- Two factor experiments-Mathematical model for two factor experiments- Applications to production problems.

TOTAL: 45 PERIODS

OUTCOMES

At the end of the course, students will be able to:

CO1: Design of experiments for research and industry.
CO2: Apply the concept of probability so that they can be used for industrial applications.
CO3: Use sampling theory and its usefulness in industrial quality control.
CO4: Apply the concepts of estimation theory to industrial problems.
CO5: Apply the test of significance and its applications to industry and research.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	✓	✓				✓	✓		✓				
CO2	✓	✓	✓								✓	✓	
CO3	✓	✓			✓						✓	✓	
CO4	✓	✓			✓		✓						
CO5	✓	✓	✓	✓								✓	

TEXT BOOKS

1. Richard I.Levin and David S. Rubin, “Statistics for Management”, Pearson India, 2018.
2. Richard Barrett clements, “Handbook of Statistical Methods in Manufacturing” , PH, 1991.

REFERENCES

1. Gupta.S.C. and Kapoor.V.K, “Fundamentals of Mathematical Statistics”, Sultanchand, 2017.
2. Hooda.R.P.,“Statistics for business and economics”, Vikas Publications, 2010.
3. Morris. H. Degroot, Mark J. Schervish , Probability and Statistics, Pearson Education, 2018.
4. Vijay K. Rohatgi, Ehsanes Saleh A.K Md, “An Introduction to Probability and Statistics” , Wiley, 2008.
5. Rukmangadachari.E, Probability and Statistics, Pearson,2012.

RP5001 ADHESIVES AND PAINTS L T P C 3 0 0 3

Objective

- To understand the concept of adhesion as a joining operation and how it compares with fastening and welding
- To appreciate the physical chemistry of adhesives and paints, mechanisms of setting and development of strength in the joints and coatings
- To understand the principles of formulating various adhesives and paints
- To understand the importance of and methods of surface preparations for adhesion and painting of substrates

UNIT I FUNDAMENTALS OF ADHESION 8

Adhesives – Fundamentals – types of substrates –mechanisms of setting, adhesive strength – thermodynamics of adhesives – concepts of surface energy, contact angle etc – types of joints – joint selection

UNIT II NON REACTIVE ADHESIVES **10**

Natural adhesives like animal glue, casein, starch – rubber based adhesives – NR, SBR, NBR, CR, IIR adhesives – Latex based & solution based – principles behind formulations – Pressure sensitive & hot melt adhesives based on SBS, EVA – polyvinyl acetate & polyvinyl alcohol based adhesives.

UNIT III REACTIVE ADHESIVES **10**

Phenolics, epoxies, acrylics, anaerobics, cyanoacrylates – uses of adhesives in civil Engineering, automobile, aerospace, electrical & electronic industries.

UNIT IV SURFACE COATINGS **9**

Components of Paints – Preparations formulations, pigment dispersion, drying & film formation mechanisms, types of paints – based on emulsion, oil, alkyds, epoxies, PF, UF etc, Urethanes, Silicones – Primers like chlorinated rubber – applications, powder coatings.

UNIT V SURFACE PREPARATION AND TESTING **8**

Surface preparation for adhesion & painting, powder coatings, factors affecting coating properties, barrier properties – rheology & its importance, paint & adhesion performance testing.

TOTAL: 45 PERIODS

CourseOutcome

The students will be able to

- understand the concept of adhesion as a joining operation
- appreciate the physical chemistry of adhesives and paints, mechanisms of setting and development of strength in the joints and coatings
- understand the principles of formulating various adhesives and paints
- understand the importance of and methods of surface preparations

REFERENCES

1. Skiest I ," Hand book of Adhesives ", Van Nostrand Reinhold, 1990.
2. Shields, "AdhesivesHand Book," Elsevier, 2008.
3. Malshe V.C, Sikchi M, "Basics of Paint Technology",Vol 1, ColourPublicatons Pvt Ltd, Mumbai, 2002
4. PhillipeCognard"Handbook of Adhesives and Sealants: Basic Concepts and High Tech Bonding",Elsevier, 2005.

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	--	--	1	1	--	1	---	---	1	3	--	--	3
CO2	3	1	1	--	--	1	1	--	--	---	----	1	3	--	1	3
CO3	3	1	-	--	--	1	1	--	2	--	----	1	3	--	1	3
CO4	3	1	--	--	--	1	1	--	1	--	----	2	3	--	1	3
Overall CO	3	1	1	-	--	1	1	--	1	---	----	1	3	--	2	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5002 ADVANCED PLASTICSPROCESSING L T P C
3 0 0 3

OBJECTIVES

- To familiarize students with the latest plastics processing technologies.
- To study about the troubleshoots and process parameters to overcome the troubleshoots

UNIT I ADVANCED INJECTION MOULDING PROCESS - I 9

Introduction - Co-injection moulding, Two-colour injection moulding process - applications,Gas assisted Injection Moulding - Basic processes and procedures - Moulding aspects -shrinkage and summary. Reaction Injection Moulding (RIM) - Process - Mould – ProcessControls – Merits.

UNIT II ADVANCED INJECTION MOULDING PROCESS – II 9

Multi-layer Moulding, Counter flow moulding, Liquid Injection Moulding processes. Thin walled moulding, Structural foam moulding - Low pressure and high pressure processes - Merits &demerits.

UNIT III ADVANCED BLOW MOULDING - I 9

Introduction - Classification of advanced Blow moulding processes - Deep draw Double Wall Blow Moulding Technology - Split moulds- Versatility - Applications. Press BlowMoulding Technology Process - Applications, Three dimensional Blow Moulding Process -Applications.

UNIT IV ADVANCED BLOW MOULDING – II 9

Stretch blow moulding - Injection stretch blow moulding - Extrusion stretch blow moulding- Process - Merits & demerits - Applications. Multi-layer Blow Moulding - Process - Applications.

UNIT V ADVANCED EXTRUSION PROCESSES 9

Introduction - Profile Extrusion - Material - Process - Process optimization - Cooling Profile applications. Process, downstream equipments - dies and application.Multi-layer film extrusion, co-extruded sheets, Corrugated pipes, profiles.

TOTAL: 45 PERIODS

OUTCOMES

At the end of the course the students will be able

- To learn the advanced processingtechniques and Product manufacture
- To know about trouble shoots and itsremedy in processing

REFERENCES

1. James F. Stevenson, “Innovation in Polymer Processing Moulding,” HanserPublishers, New York, 1996.
2. Donald V. Rosato, “Injection Moulding Handbook,” International ThomsonPublishing Company, 1985.
3. Friedhelm Henson, “Plastics Extrusion Technology,” Hanser Publishers, New York,1988.
4. Brunt Strong, “Plastics: Materials and Processing,”Prentice-Hall, New Jersey,1996

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	3	3	3	3		3				2	3	3	2	3	3
CO2	2	3	3	3	3		3				2	3	3	2	3	3
Overall CO	2	3	3	3	3		3				2	3	3	2	3	3

1, 2 and 3 are correlation levels with weightingss as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5003 BIOPOLYMERS AND POLYMERS FROM RENEWABLE RESOURCES

L	T	P	C
3	0	0	3

OBJECTIVES

To Impart knowledge to the students in the following:

- Biopolymers fundamentals
- Properties and applications of PLA, PHA, Starch
- Proteins, hemicellulose, cellulose and its derivatives
- Biopolymers in Packaging applications
- Biopolymers in the field of agriculture

UNIT- I GREEN CHEMISTRY FOR POLYMERS 9

Raw materials for polymers – Sustainability of Petroleum resources - Need for Alternate Sources for Polymers –Polymer Recycling and Environmental Issues – Bio derived Polymers - Biodegradation and its Evaluation techniques – Standards for biodegradation – Need for biodegradation of packaging materials – Introduction to Life Cycle Assessment – Monomers from biosources.

UNIT - II RESOURCES FOR BIOPOLYMERS 9

Polysaccharide based polymers – Gelatinization – Starch based blends - Biodegradation of Starch based Polymers - Production of Lactic acid and Polylactide - Properties and applications of Polylactides – Introduction to Polyhydroxyalkanoates and their derivatives – Applications – Chitin & Chitosan and its derivatives as biopolymers

UNIT-III PROTEINS, HEMICELLULOSE AND CELLULOSE BASED BIOPOLYMERS 9

Plant and animal based Proteins – Solution casting of proteins – Processing of proteins as plastics – preparation and properties of hemicellulose – Cellulose based Composites – Surface and Chemical modifications of Cellulose fibers

UNIT- IV PACKAGING APPLICATIONS OF BIOPOLYMERS 9

Food Packaging – Functional Properties – safety and Environmental aspects – Shelf life – Films and coatings in Food Applications – Materials for edible films and coatings – Biopolymer coatings for paper and paperboard – Bio-nanocomposite films and coatings

UNIT- V BIOPOLYMER APPLICATIONS IN AGRICULTURE 9

Biopolymer Films – Biodegradable mulching – Advantages and Disadvantages - Chemical sensors – Biosensors - Functionalized Biopolymer Coatings and Films – Applications of biopolymers in horticulture

TOTAL: 45 PERIODS

COURSE OUTCOMES

Students will be able to:

- Appreciate the importance of sustainable materials
- Understand the properties and applications of PLA, PHA and Starch derivatives
- Know the properties and applications of Cellulose, proteins and hemi - cellulose
- Recognizethe importance of biopolymers in the field of Food packaging.
- Identifythe importance of biopolymers in the field of Agriculture.

REFERENCES

1. David Plackett, “Biopolymers – New Materials for Sustainable films and Coatings”, John Wiley & Sons Ltd, 2011
2. David Kaplan, “Biopolymers from Renewable resources”, Springer, 1998
3. Carmen Scholz, Richard A Gross, “Polymers from Renewable Resources: Biopolymers and Biocatalysis”, American Chemical Society, 2001.
4.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	3	1	3	3	1				2	3		3	2
CO2	3	3	3	3	1	3	3	1				2	3		3	2
CO3	3	3	3	3	1	3	3	1				2	3		3	2
CO4	3	3	3	3	1	3	3	1				2	3		3	2
CO5	3	3	3	3	1	3	3	1				2	3		3	2
Overall CO	3	3	3	3	1	3	3	1				2	3		3	2

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5004 **DESIGN OF MACHINE ELEMENTS** **L T P C**
3 0 0 3

OBJECTIVES

To expose the students to:

- The design and theory of common machine elements
- Practice the students in solving design problems involving various machine elements.
- Familiarize with design of components subjected to various stresses and moments like direct stress, bending stress, twisting moment and combined stresses.

UNIT I INTRODUCTION AND FUNDAMENTALS OF DESIGN 9

Introduction to the design concept and its role in the design of mechanical elements. Stages in Design, General consideration and factors influencing the design of machine elements and design process. Design criteria- Factor of safety -Selection of Materials -Standards and Codes – Economical and reliable design—Basic Design equations for various loading and various sectional elements-Design against static loading – modes of failure - Principal stresses, Theories of Failure – stress concentration- Eccentric loading.

UNIT II DESIGN FOR VARIABLE LOADING 9

Variable loading-Cyclic stresses, Fatigue and endurance limit, Notch sensitivity, Fatigue Stress concentration. Design against variable loading -Fatigue Failure, SN curve-Endurance limit, Design for finite and infinite life, Soderberg and modified soderberg- Goodman and modified goodman Criteria- Gerber criteria. Case studies.

UNIT III DESIGN OF JOINTS, SHAFTS AND COUPLINGS 9

Design of Bolts under Static load - Design of bolts subjected to fatigue – Design of riveted joints- Design of shaft – for static and varying loads, for strength and rigidity – Design of Coupling – types- flange, Muff and flexible rubber bushed coupling.

UNIT IV DESIGN OF TRANSMISSION ELEMENTS 9

Design of Spur, Helical, Bevel and Worm gear drives – Design of belt drives – flat and V belts

UNIT V DESIGN OF SPRINGS AND BEARINGS 9

Design of Helical Spring – types, materials, static loading – Design of leaf spring – Design of Journal Bearing – Anti friction Bearing – types, life of bearing, reliability consideration, selection of ball and roller bearings.

TOTAL: 45 PERIODS

OUTCOMES

Students will be able to:

- Understand the importance of economical and reliable design.
- Differentiate the constant loading design and variable loading design
- Know the design procedure for various mechanical elements design.
- Understand the design procedure for various power transmission elements.
- Identifythe importance of material selection in design and its influence

TEXT BOOK

1. Shingley J.E, Mischke C., “Mechanical Engineering Design”, Mc Graw Hill, International Edition, 1992

REFERENCES

1. Bhandari V.B, “Design of Machine Elements”, Tata McGraw Hill Publishing Co Ltd, 1993
2. Sharma C.S, Purohit K., “Design of Machine Elements”, Prentice Hall of India Pvt Ltd, 2003
3. Norton R.L, “Machine Design – An Integrated Approach”, Prentice Hall, International Edition, 2000

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	3	3	3	3	3		3				2	3	3	2	3	3
CO2	3	3	3	3	3		3				2	3	3	2	3	3
CO3	3	3	3	3	3		3				2	3	3	2	3	3
CO4	3	3	3	3	3		3				2	3	3	2	3	3
CO5	3	3	3	3	3		3				2	3	3	2	3	3
Overall CO	3	3	3	3	3		3				2	3	3	2	3	3

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP 5005 ENGINEERING AND HIGH PERFORMANCE PLASTICS

L	T	P	C
3	0	0	3

OBJECTIVES

- To impart knowledge on properties and applications of Engineering plastics
- To make them understand the structure property relationship and applications of high temperature polymers.
- To highlight the applications of specialty polymers.

UNIT- I ENGINEERING PLASTICS 10

Polyamides, (nylons), modified polyamides, polyesters – PET, PBT, Polyacetals, PC and its blends – Preparation, properties & applications,

UNIT- II HIGH TEMPERATURE PLASTICS 10

Fluorine containing Plastics – Preparation, properties & uses of PTFE, PCTFE, PVDF, other high performance plastics like PPO, PPS, polysulphones, PEEK, Polyimides, Polybenzimidazoles, aromatic polyamides – Kevlar, Nomex – Preparation, properties & applications.

UNIT-III SPECIALTY POLYMERS - I 9

Polymers for electronic applications, conducting polymers – Photoresists, polymers in optoelectronics polymers with piezoelectric, pyroelectric& ferroelectric properties, Polymers in telecommunications and power transmission

UNIT – IV SPECIALTY POLYMERS -II 9

Synthetic polymer membranes, ionic polymers, hydrogels and smart polymers, dendritic polymers, shape memory polymers, LCP's, IPN's

UNIT V POLYMERS FOR BIO MEDICAL APPLICATIONS 7

Bio- compatible and bio degradable polymers, Controlled drug release, tissue engineering, orthopaedic application, dentistry.

TOTAL: 45 PERIODS

OUTCOMES

- Students understand the importance Engineering plastics.
- Students acquire fundamental knowledge about properties and uses of high temperature plastics.
- Students acquire sound information on specialty polymers.

REFERENCES

1 .R.W. Dyson “Specialty Plastics” 2nd edition, Blackie Academic & Professional,1988.
2. James M. Margolis “ Engineering. Plastics Handbook” McGraw – Hill, 2006.
3. “Engineering Plastics”, Vol.2, ASM International, 1988.
4. ManasChanda, Salil.K.Roy, “Plastics Technology Hand book”, 2nd edition, Marcel Dekker, New York, 1993.
5. Matrin.T.Goosey, “Plastics for Electronics”, Elsevier, Applied Science, 1985.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	3	2	3	3	3					3		3	3
CO2	3	3	3	3	2	3	3	3					3		3	3
CO3	3	3	3	3	2	3	3	3					3		3	3
Overall CO	3	3	3	3	2	3	3	3					3		3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5006 FINITE ELEMENT ANALYSIS FOR POLYMERS L T P C
3 0 0 3

UNIT- I INTRODUCTION 8

Review of various approximate methods – Raleigh Ritz's, Galerkin and finite difference methods- Governing equation and convergence criteria of finite element method.

UNIT - II DISCRETE ELEMENTS 10

Bar elements, uniform sections, mechanical and thermal loading, varying section, truss analysis, Beam element- problems for various loadings and boundary conditions – longitudinal and lateral vibration – use of local and natural coordinates

UNIT- III CONTINUUM ELEMENTS 8

Plane stress, plane strain and axisymmetric problems. Derivation of element matrices for constant and linear strain triangular elements and axisymmetric elements

UNIT- IV ISOPARAMETRIC ELEMENTS & FIELD PROBLEM 10

Definitions, shape function for 4,8 nodal quadrilateral elements, stiffness matrix and consistent load vector, Gaussian integration Heat transfer problems, steady state fin problems

UNIT- V NON LINEAR ANALYSIS 9

Elastomers- Elastic material model correlation-Terminology-Types of FEA models-Model building- Non linear material behavior- Boundary conditions-Applications-case studies

TOTAL: 45 PERIODS

Outcome

- Develop depth knowledge on techniques of FEA and tools for analysis of polymer products
- Get idea of implementation of computer on solving FEA based problems.
- Discretize and solve one-dimensional solid mechanics and heat transfer problems in FEA.
- Analyze a non-linear behavior of polymer through FEA and control it's parameters

REFERENCES

1. Tirupathi.R. Chandrapatha and Ashok D. Belegundu,"Introduction to Finite Elements in Engineering",PrinticeHallIndia, Third Edition, 2003.
2. Rao S.S, "Finite Element Methods in Engineering", Butterworth and Heinemann, 2001
3 Reddy J.N. "An Introduction to Finite Element Method ", McGraw Hill, 2000.
4 Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw Hill, 2000.
5 Bathe, K.J. and Wilson, E.L., "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.
6 Alan N Gent, "Engineering with Rubber", 2nd Edition, Carl Hanser Verlag, Munich 2001.
Robert D Cook, David S malkus, Michael E Plesha, "Concepts and Applications of Finite Element Analysis", 4th edition, John Wiley and Sons, Inc., 2003

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	2	-	3	1	-	-	-	-	2	3	3	3	-	1
CO2	3	2	1	-	3	1	-	-	-	-	2	2	3	3	-	1
CO3	3	3	2	-	2	2	-	-	-	-	1	3	-	2	-	1
CO4	3	3	1	-	3	2	-	-	-	-	2	3	1	3	-	1
Overall CO	3	3	2	-	3	2	-	-	-	-	2	3	2	3	-	1

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5007 FRACTURE AND FAILURE IN POLYMERS L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge on concepts in fracture mechanics
- To understand the various stages in fracture.
- To impart the knowledge on dynamic effect in various fractures.

UNIT- I FATIGUE OF STRUCTURES 10

S.N. curves - Endurance limits - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves. Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques

UNIT- II FRACTURE MECHANICS 12

Phases in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces. Strength of cracked bodies - Potential energy and surface energy - Griffith's theory - Irwin - Orwin extension of Griffith's theory to ductile materials - Stress analysis of "cracked bodies - Effect of thickness on fracture toughness" - Stress intensity factors for typical geometries.

UNIT- III FRACTURE INITIATION 9

Yielding- microvoiding and crazing- Fracture toughness of various plastics-PMMA-PS-PC-ABS-PVC-PP-PE-Thermoset resin-FRP-Rubbers.

UNIT- IV SLOW CRACK GROWTH AND STABILITY 7

Time dependent fracture- Environmental crack and Zone growth-Other controlling mechanisms- fatigue- Visco elastic behavior- Ductile tearing.

UNIT- V IMPACT TESTING AND DYNAMIC EFFECTS 7

Dynamic effects in impact testing- Applications to small scale yielding- Applications to contained yielding- Rate effects- General dynamic analysis

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

- Understand the various concepts in fracture mechanics
- Acquire the knowledge on various stages in fracture with specific fracture analysis for various polymeric materials.
- Familiarize the importance of dynamic effects in fracture.

REFERENCES:

1.Prasanth Kumar ,"Elements of fracture mechanics", Wheeter publication, 1999.
2.Villiams J.G.," Fracture mechanics of Polymers", Ellis Horwood Limited, John wiley&sons, New york, 1984
3. Sih C.G., "Mechanics of fracture." Vol - I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
4. Knott, J.F., "Fundamentals of Fracture Mechanics," - Buterworth& Co., Ltd., London, 1983.
6. KareHellan ,'Introduction to Fracture Mechanics', McGraw Hill, Singapore,1985

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	3	3		3						3	1	2	3
CO2	3	3	3	3	3		3						3	1	2	3
CO3	3	3	3	3	3		3						3	1	2	3
Overall CO	3	3	3	3	3		3						3	1	2	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5008 LATEX SCIENCE AND TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge on natural rubber latex processing
- To understand the various latex product manufacturing process
- To impart the knowledge on synthetic latex and its applications

UNIT- ILATEX CHARACTERISTICS AND CONCENTRATION METHODS 9

Definition of Latex, classification, Latex particle size and distribution, stability and destabilization of latices, Comparison between latices and polymer solution; Natural rubber latex –origin, tapping, bulking and preservation, composition of field latex, properties, preservation, methods of concentrating latex - creaming, centrifuging, & evaporation,– Specification and testing- (National and ISO) for latex grades (ASTM D 1076)

UNIT- II LATEX COMPOUNDING 9

Latex compounding-Ingredients, Preparation of Dispersions, Emulsion, Slurries; Machineries- Ball mill, Pearl mill; Preparation of latex compound and maturation; Prevulcanized latex, MG Latex, -Preparation, properties and application; Evaluation of the latex compound- Chloroform number, swelling index test; Design for latex products formulation.

UNIT- III LATEX DIPPING PROCESS 9

Principle and types of dipping process, Dipping plant design, formers, sequence of operation, post processing; Manufacture of Condoms, Gloves, Catheters, Balloons- formulations, process, specification, testing and troubleshooting.

UNIT- IV LATEX FOAM, SHEETING AND SPRAYING 9

Principle and Manufacture of Foam-Dunlop and Talalay process, Compound design-Process details, Foam properties, testing and defects, foam applications; Latex sheeting; latex binders and carpet backing- Basics and process.

UNIT- V EXTRUSION AND PRODUCTS BASED ON SYNTHETIC LATEX 9

Principle and Manufacture of latex elastic threads; latex tubing; latex casting process specification and testing, defects. Synthetic latex- Types, properties, and application- surface coatings, adhesives, paper industries.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

- Understand the Natural rubber latex processing
- Acquire the knowledge on various Latex product manufacturing
- Familiarize the importance of synthetic latex and its applications

REFERENCES:

1. Blackley, D.C., “High Polymer Latices”, Vol 1 and 2, Chapman & Hall, 1997
2. Mausser,R.F., “The Vanderbilt Latex Hand book” 3rdedn.R.T. Vanderbilt Company, 1987.
3. Calvert, “Polymer Latex and Applications”, Applied Science Publishing Ltd, 1985.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3		3				2	3	3	2	3	3
CO2	3	3	3	3	3		3				2	3	3	2	3	3
CO3	3	3	3	3	3		3				2	3	3	2	3	3
Overall CO	3	3	3	3	3		3				2	3	3	2	3	3

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5009 MOULD ENGINEERING AND MANUFACTURE L T P C
3 0 0 3

OBJECTIVES To impart knowledge on:

- Various mould making techniques
- Conventional and special Machining operations
- Various mould materials
- Material selection and
- Quality control concepts in mould making.

UNIT I PRODUCTION PROCESSES FOR MOULD MAKING 9

Introduction: Casting process- material removal processes, types of machine tools – metal Cutting -Chip formation, cutting tool materials, tool wear, tool life, surface finish, cutting fluids. Centre lathe- Various operations-Capstan and turret lathes - Special attachments-Reciprocating machine tools: shaper, planer, slotter - Milling- various operations-Broaching machines-types and operations- Grinding process – types and operations.

UNIT II MOULD ENGINEERING AND MATERIALS 9

Mould–function-requirement-mechanical properties- tolerance-basic mould types-Mould construction nomenclature- Stress relieving -Heat treatment-mould steel requirements-Selection of steel for mould-Surface treatments- Alloy steels-Non Ferrous materials for moulds.

UNIT III UNCONVENTIONAL MACHINING PROCESSES 9

Electrical Discharge Machining (EDM)- working Principle. Parameters-Surface Finish and MRR- electrode - Wire cut EDM – Applications. Chemical machining and Electro-Chemical machining - Etchants- Maskants- Techniques of applying maskants-Process Parameters – Surface finish and MRR-Applications. Principles of ECM-Equipment's-Surface Roughness and MRR-Process Parameters.

UNIT IV ADVANCED MOULD MAKING TECHNIQUES 9

Mould Making Techniques: Pantograph engraving- Hydro copying CNC machines-CNC Lathe-CNC Milling-CNC EDM –CNC programming-Advantages and its Applications –Rapid prototyping techniques-Mould polishing techniques.

UNIT V QUALITY CONTROL IN MOULD MANUFACTURE 9

Introduction to Tool Room measuring instruments-Vernier-Micrometer–Height Gauge –Slip Gauge-Dial Gauge-Measuring tapers and angles-CMM- Mould maintenance.

TOTAL: 45 PERIODS

REFERENCES

1. HajraChoudry, “Elements of Work Shop Technology – Vol. II”, Media Promoters.2002.
2. Herbert Rees, Mould Engineering, 2nd edition, Hanser Publishers.
3. Benedict. G.F. “Nontraditional Manufacturing Processes” Marcel Dekker Inc., New York (1987).
4. HMT – “Production Technology”, Tata McGraw-Hill, 1998.
5. Mikellp.Groover, ‘ Fundamentals of modern Manufacturing, Materials, Processess and systems’ John Wiley and Sons, 9th Edition,2007.
6. Shrawat N.S and Narang J.S, ‘CNC Machines’ , Dhanpat Rai & CO., 2002.
7. Milton C. Shaw, ‘ Metal Cutting Principles’ , Oxford university Press, second Edition 2005.
8.Richard R. Kibbe John E. Neele, Roland O Meyer,Warran T. White, Machine Tool Practices, Prentice Hall of India Pvt. Ltd., 1999

OUTCOMES

To make the student to familiarize with

- Design mold manufacturing steps along with material selection, surface treatment
- Understand inspection, quality control of molds.
- Understand basics of CNC machine
- Theory of metal cutting and lathe operations

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	3	3	1	3	1					3	3	3	3
CO2	3	3	3	3	3	1	3	1					3	3	3	3
CO3	3	3	3	3	3	1	3	1					3	3	3	3
CO4	3	3	3	3	3	1	3	1					3	3	3	3
Overall CO	3	3	3	3	3	1	3	1					3	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5010	POLYMERS IN PACKAGING TECHNOLOGY	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge on

- On needs and functions of packaging materials
- Various methods of packaging to improve the shelf life of the products
- Testing of packaging materials

UNIT-I INTRODUCTION TO PACKAGING 9

Definition, functions of packaging, types and selection of package, packaging hazards, interaction of package and contents, materials and machine interface, environmental and recycling considerations-Life cycle assessment; Package design-Fundamentals, factors influencing design, stages in package development.

UNIT - II DIFFUSION AND PERMEABILITY 9

Diffusion-Types of diffusion, Fick's law of diffusion and applications; Diffusion coefficients of gas, liquid and vapour in polymers and packaging films, techniques to measure diffusion coefficient in polymer interface; Polymer permeability, gaseous transport in polymers, permeability measurement.

UNIT-III PACKAGING TECHNIQUES 9

Flexible and Rigid Packaging-Extrusion- Blown film, cast film, multi-layer film and sheet, lamination; Injection moulding; Blow moulding;Thermoforming; Surface treatment for printing and printing processes.

UNIT-IV SPECIALITY PACKAGING 9

Aerosol packaging, shrink and stretch wrapping, blister packaging, antistatic packaging, aseptic packaging, active packaging, modified atmospheric packaging, ovenable package, cosmetic package, hardware packaging, food packaging, textile packaging, health care packaging, export packaging.

UNIT-V TESTING OF PACKAGING MATERIALS 9

Package Testing- Mechanical properties – Tensile and tear properties, Impact properties, Burst strength, Stiffness, Crease or flex resistance; Co-efficient of friction, Blocking Orientation and Shrinkage; Optical Properties – Clarity, Haze and gloss; Barrier Properties – Oxygen transmission, Water vapour transmission rate migration; Chemical resistance tests

TOTAL: 45 PERIODS

OUTCOMES:

Upon completing this course, the students will be able to

- Apply and examine the knowledge of properties for selection of packaging materials
- Select between different techniques of packaging
- Will familiarize in testing of plastic packaging
-

REFERENCES:

1. Aaron L Brody Kenneth S Marsh, “Encyclopedia of Packaging Technology”, Wiley, 1997.
2. A.S. Athayle, “Handbook of Packaging Plastics”, Multi Tech publishing Co, First edition, 1999
3. Selke, S. E. M., Culter, J. D. and Hernandez, R. J., “Plastics Packaging: Properties, Processing, Applications and Regulations”, Carl Hanser Verlag, USA, 2004

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	3	3		3		2	1	2		3	3	3	3
CO2	3	3	3	3	3		3		2	1	2		3	3	3	3
CO3	3	3	3	3	3		3		2	1	2		3	3	3	3
Overall CO	3	3	3	3	3		3		2	1	2		3	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP 5011 POLYMER RECYCLING

L	T	P	C
3	0	0	3

OBJECTIVES

To Impart knowledge to the students in the following:

- Segregation and sorting of plastics
- Polymer degradation mechanism
- Recycling of plastics
- Understand the importance of quaternary recycling
- Rubber recycling

UNIT-I INTRODUCTION TO RECYCLING 6

Need for recycling –Source of Plastic waste – Life cycle analysis – Legislations related to polymer recycling - depolymerization - Ceiling temperature and its importance – Degradation – Biodegradation, Primary, Secondary, Tertiary recycling and Quaternary recycling

UNIT- II SORTING TECHNIQUES 8

Density based – Optical sorting – Electrostatic sorting – Sorting by melting temperature – Sorting by selective dissolution- sorting of metal contaminants, size reduction - cutting – Densification – Pulverization – Chemical methods, melt filtration of contamination in recycled plastics – screen changers – filtration requirements of different recycled plastics.

UNIT-III RECYCLING OF MATERIALS- I 12

Recycling of PET – PET separation – Melt reprocessing – Chemical reprocessing – Energy recovery – application HDPE recycling – Application of HDPE recyclate – LDPE recycling – Application of LDPE recycle LDPE – film recycling – Polypropylene recycling – Application of recycled PP – Recycling of polystyrene - Application of Recycled EPS.Nylon recycling – Chemical recycling – Mechanical recycling – applications Depolymerization-case studies (PMMA, PS, polyacetals)

UNIT – IV RECYCLING MATERIALS- II 11

Recycling of Engineering Thermoplastics – PC – ABS& e-wastes - Mechanical and chemical recycling of polyacetals – Uses, recycling of polyurethanes – Physical methods – Chemical methods, Feed stock recycling and energy recovery.

Recycling of PVC - Separation techniques for PVC and PET – size reduction – melt filtration – Mechanical recycling – chemical recycling – Energy recovery – applications.Feed Stock Recycling – Pyrolysis – kiln / Retort – Fluidized bed – application – Hydrogenation of plastics waste – Gasification – different gasification process – economic aspects – Incineration of plastic waste with energy recovery

Recycling of Thermoset composites – grinding of SMC – selective chemical degradation of SMC scrap – solvent recycling – pyrolysis – Energy recovery from SMC scrap – Recycling of thermoplastics composites

UNIT-V RUBBER RECYCLING 8

Tyre size reduction – Application of ground Rubber crumb – Filler – Bound Rubber products – Thermoplastics binder – Civil engineering applications – Surface treated crumb rubber – applications – Rubber reclaiming and devulcanization scrap rubber and fuel source (Tyre derived fuel TDF) – Pyrolysis.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

- Appreciate the importance of sorting techniques
- Understand the different degradation mechanisms
- Identify right techniques to recycle thermoplastics
- Know the importance of closed loop recycling.
- Recognize methods to recycle scrap rubber

REFERENCES:

1. John Scheirs, “Polymer Recycling Science, Technology and Applications,” JohnWiley& Sons, 1998.
2. Ann Christine Albertson and Samuel J Huang, “Degradable Polymers, Recycling and Plastics,” Marcel Dekker Inc, 1995.
3. Randall Curlec, T. and Sujit Das, “Plastics Wastes: Management Control, Recycling and Disposal,” US Environmental Protection Agency, Noyes Data Corporation, 1991.
4. Gerald D Andrews and Pallatheri M Subramanian, “Emerging Technologies in Plastics Recycling,” ACS Symposium Series, 513, 1992.
5. Mustafa.N. “Plastics Waste Management Disposal Recycling and Reuse,” Marcel Dekker Inc, 1993.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	3	2	3	3	3	2		3	2	3	1	3	3
CO2	3	3	3	3	2	3	3	3	2		3	2	3	1	3	3
CO3	3	3	3	3	2	3	3	3	2		3	2	3	1	3	3
CO4	3	3	3	3	2	3	3	3	2		3	2	3	1	3	3
CO5	3	3	3	3	2	3	3	3	2		3	2	3	1	3	3
Overall CO	3	3	3	3	2	3	3	3	2		3	2	3	1	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5012 POLYURETHANE SCIENCE AND TECHNOLOGY L T P C
3 0 0 3

UNIT-I PRINCIPLES OF PU CHEMISTRY AND SPECIAL APPLICATIONS 12

Reactions of isocyanate group-building blocks for PUs-polyols, isocyanates, chain extenders – Preparation methods like prepolymer process, one shot process-preparation of aqueous two phase systems – Special areas like ionomers,LCP based on PUs, hydrogels, promoters-Uses in medical areas, bio technology, optical lenses etc Structure-property relationships in hard and soft segments - Morphology of domains-Effect of cross links on PU properties, structure-property relationships in ionomers

UNIT-II RAW MATERIALS AND AN OVERVIEW OF PROCESSING OF PU 6

Polyols, isocyanates – Their preparation and characteristics, conversion products of the raw materials – Additives – Industrial hygiene –Principles of PU processing

UNIT-III PU FOAMS 9

Flexible foams-Their production-Equipment and process, properties and uses -Rigid foams-Production and properties-Relationship between production methods and properties, uses – Integral skin foams- RIM

UNIT-IV SOLID PU MATERIALS 9

Casting of PUs, TPUs- Chemistry, manufacturing, processing, compounding and uses, millable PUs-preparation, properties and uses

UNIT- V PU COATINGS AND ADHESIVES 9

Solvent based coatings, air dried coatings, solvent free paints and coatings, applications of PU based coatings two components and one component adhesives based on PUs, solvent based adhesives, dispersion adhesives, hot melts, PU binders.

TOTAL: 45 PERIODS

COURSE OUTCOME:

The students will be able to

- understand the formation of polyurethanes- castable products, TPEs, and the necessary raw materials
- understand the structure-property relationships in PUs
- gain knowledge about various production methods for PU products

REFERENCES:

1. Oertel G(Ed), “PU Handbook”, II Edition, Hanser, 1993.
2. Hepburn C, “PU Elastomers II” Edition, Springer Science, 1992.

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	--	--	1	1	--	--	---	---	2	3	--	--	3
CO2	3	1	1	--	--	1	1	--	--	---	----	1	3	--	1	3
CO3	3	1	-	--	--	1	1	--	--	--	----	2	3	--	1	3
Overall CO	3	1	1	-	--	1	1	--	-	---	----		3	--	2	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5013 PRODUCT DEVELOPMENT AND COST ESTIMATION

L	T	P	C
3	0	0	3

UNIT- I INTRODUCTION TO PRODUCT DEVELOPMENT 9

Selection of the right product – Steps in product development– Research – Types - Source and types of data – Types of survey - Market research and development - Criteria for a successful product - production, functional , operational, modular, aesthetic, quality, durability and reliability aspects – Design optimization - Product life cycle – Case study.

UNIT- II PROCESS PLANNING 9

Process Planning – Objective – Information required – Make or buy decision - Process selection - Process Sheet – Steps to prepare detailed process sheets – case studies – Break even analysis – Applications.

UNIT- III ESTIMATING, COSTING AND ELEMENTS OF COST 9

Cost estimation – importance of estimation – Costing – importance of costing – Difference between costing and estimation – Importance of realistic estimates – Estimation procedure – Elements of cost – Material Cost – Determination of Material cost – Labour cost – Determination of Labour Cost – Expenses – Cost of Product (Ladder of cost) – Illustrative examples.

UNIT- IV ANALYSIS OF OVERHEAD EXPENSES 9

Overhead expenses – Factory expenses – Depreciation – Causes of depreciation – Methods of depreciation – Administrative expenses – Selling and Distributing expenses – Allocation of overhead expenses – Critical analysis of a typical product.

UNIT- V AN OVERVIEW ON INTELLECTUAL PROPERTY RIGHTS 9

Intellectual Property Rights (IPR) – Significance –International protection of IPR - Forms of IPR – Patent – Copyright – Trademark – Industrial Design – Commercialization – Others - Case study.

TOTAL: 45 PERIODS

REFERENCES

1. Narang G B S and Kumar V , “Production and Costing”, Khanna Publishers, 2000.
2. Banga TR and Sharma S C , “Estimating and Costing”, Khanna Publlishers, 2000.
3. Khanna O P,”Mechanical Estimating and Costing”, Dhanpat Rai Publications, 1999.
4. Mahajan M, “Industrial Engineering and Production Management”, Dhanpat Rai Publication,2008.
5. Narayanan P, “Law of Copyright and Industrial Designs”, Eastern law House, 2010.
6. Wadehra B.L., “Law relating to Patents, Trade Marks, Copyright, Designs and Geographical Indications”, Universal law Publication, 2000.
7. G. P. Reddy, “Intellectual Property Rights & Other Law”, Gogia Law Agency, 2004

Course Outcome:

The students will be able to

- understand the basic factors which go into product design in general
- understand the role of process planning towards product development
- gain knowledge about arriving at costing of a product covering various fixed and variable costs
- get some understanding about IPRs

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	--	--	2	2	1	1	---	3	2	3	--	2	3
CO2	2	1	1	--	--	2	2	2	2	---	3	1	3	--	1	3
CO3	2	1	2	--	2	2	-	2	2	--	3	1	3	--	1	3
CO4	-	-	-	-	-	2	1	3	1	2	3	1	-	-	1	3
Overall CO	2	1	1	-	1	1	2	2	1	1	3	1	3	--	2	3

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5014 RUBBER AND PLASTICS TESTING L T P C
3 0 0 3

OBJECTIVES

- To enlighten the students on knowledge of standards and specifications of rubber and plastics testing.
- To learn the specimen preparation, conditioning and testing requirements.
- To impart the knowledge on various testing machines and procedures as per the standards.
- To understand the various tests performed for rubber and plastics compound and products

UNIT I TESTS ON RUBBER COMPOUNDS 9

Principles of Testing- Standards and specification –Line Call - out– Nomenclature- ISO and DIN, ASTM & BIS standards– Scorch and cure parameters – Techniques and instruments – Types of curemeters – Principles, applications of cure data - Processability Testing, Principle and Application.

UNIT II TESTS ON RUBBER VULCANISATES 10

Mechanical properties –Hardness, tear, tensile, compression & shear - application of testdata and abrasion.Fatigue – Flex cracking and cut growth – Heat buildup – Principle and applications. Effectof environment – Oxygen, heat, ozone, low temperature and swelling media; Rubber to non-rubber substrate adhesions – Product and standard methods of testing.

UNIT IV PLASTICS TESTING - I 10

Tests on raw materials - Melt flow index – Density – Moisture analysis – Tests on thermosets – Spiral flow tests - Bulk factor –Gelation tests – Tensile strength – Modulus – Hardness of plastics – Flexural strength –Impact strength – Tests for fatigue loading – Coefficient of friction – Static and dynamic - Flammability test - Heat deflection temperature – Vicat softening point – Brittleness temperature test.

UNIT V PLASTICS TESTING- II 10

Thermal expansion –– Thermal conductivity –- Resistivity measurements – Dielectric properties - Tracking index – Arc resistance – Refractive index - Gloss – Transmittance – Reflectance – Colour measurement - Gas and Water vapour permeability test – Stain resistance – ESCR – Salt spray test - Accelerated weathering test – Outdoor weathering test – Fungi and Bacteria resistance.

UNIT V TESTS ON PRODUCTS 6

Blow molded polyethylene container – PVC pipes – Rigid Foam - rubber seals & Gaskets – Engine Mount – PET bottles – Rubber hoses – Conveyor Belt.

TOTAL: 45 PERIODS

OUTCOMES:

The students can able to

- Familiarize about various test methods on Rubber and Plastics used in industry
- Use different standards
- Assess and analyze the properties and performance of the product in service condition
- Work with various testing machineries
- Predict the life of the compound or product.

REFERENCES:

1. Brown R P, “Physical Testing of Rubber,” Elsevier, 1986.
2. Mathur A B, “Testing and Evaluation of Plastics” Allied Publishers (P) Ltd., 2003.
3. Smith, Len, “Language of Rubber,” Butterworth- Heinemann Ltd., 1993.
4. Schaefer R, “Dynamic Properties of Rubber (1-8) Series,” Rubber World, Vol.211, 1995.
5. Handbook of Plastics Testing Technology, Wiley Publication, 2007 (e-book)
6. ASTM Standards Volumes 8 and 9, 2015.
7. Vishu Shaw, Hand Book of Plastics Technology, 2nd Edition, Wiley Interscience, 1998.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1			3	3	3		3	2	1			3	3	2	3	3
CO2	2	2	3	3	3		3	2	1			3	3	2	3	3
CO3	2	2	3	3	3		3	2	1			3	3	2	3	3
CO4	2	2	3	3	3		3	2	1			3	3	2	3	3
CO5	2	2	3	3	3		3	2	1			3	3	2	3	3
Overall CO	2	2	3	3	3		3	2	1			3	3	2	3	3

1, 2 and 3 are correlation levels with weightingsas Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5015 RUBBER COMPONENTS IN AUTOMOBILES

L	T	P	C
3	0	0	3

Objectives

To impart knowledge on

- Selection of materials for various automobile components
- Structure - property relationship of polymers
- Materials for Rubber springs, fluid sealing and flexible couplings and hoses

UNIT- I INTRODUCTION 6

Identification of plastics / rubber components in automobiles – Function – Selection criteria.

UNIT- II STRUCTURE-PROPERTY RELATIONSHIPS IN RUBBERS 10

Resilience, creep, hysteresis and damping, stability, set and stress relaxation, behaviour in dynamic applications.

UNIT- III VIBRATION AND RUBBER SPRING 10

Principles of vibration isolation – Rubber mounts – Spring design – Comparison with metallic springs – Shape factor and its effect – Forced and free vibrations with damping – Typical mounts, compounding and manufacture.

UNIT- IV FLUID SEALINGS AND FLEXIBLE COUPLINGS AND HOSES 10

Seals for static and dynamic applications – Effect of heat / oil ageing – Frictional behaviour – Fundamental of sealability.

UNIT- V COMPOUNDING AND MANUFACTURE 9

Types of couplings – Specification and selection – Torque vs deflection relationship – Brake fluid / hydraulic hoses, materials and manufacture

TOTAL: 45 PERIODSOUTCOMES

On successful completion of this course the students will be able to

- Select right rubber for various automobile components
- Understand structure - property relationship of rubbers
- Choose materials for spring, fluid sealing and flexible couplings and hoses

REFERENCES

1. Freakley.P.K., and Payne A.R., “Theory and Practice of Engineering with Rubber”, Applied Science Publishers Ltd., 1978.
2. Gobel.E.F., “Rubber Springs Design”, Newnes-Butterworths, Guildford, UK 1974.
3. Blow.C.M. and Hepburn C., “Rubber Technology and Manufacture”, Butterworth-Heinemann, 1982.

The scope of the subject will include studies on the following components:

Cylinder head gasket	:	ACM, Silicon
Oil Pan gasket	:	ACM
Blow-by Circuit hose	:	NBR / PVC, CM, FKM/EVA, FKM/VMQ
Vacuum Hose	:	CR, CM, AEM
Oil Circuit and blow-by seals	:	AEM, FPM, HNBR
Oil hose	:	AEM
Oil filter base gasket	:	NBR, AEM and ACM
Dipstick guide	:	HNBR
Dipstick seal	:	NBR ,FPM
Drain plug seal	:	NBR, ACM
Air filter intake duct	:	TPV-(EPDM+PP)
Throttle valve intake duct	:	TPV-(EPDM+PP), EPDM, NBR/PVC, CM, ECO
Throttle valve seals	:	NBR
Air intake manifold seals	:	NBR
Cooling Hose	:	EPDM
Cooling Seals	:	EPDM

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	3	3		3	2	2				3	2	3	3
CO2	3	3	3	3	3		3	2	2				3	2	3	3
CO3	3	3	3	3	3		3	2	2				3	2	3	3
Overall CO	3	3	3	3	3		3	2	2				3	2	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5016 TECHNOLOGY OF POLYMER BLENDS

L	T	P	C
3	0	0	3

UNIT- I THEORY OF POLYMER BLENDS 9

Flory – Huggins treatment of polymer mixtures –Phase diagrams and Miscibility gaps - Effect of temperature on the miscibility of polymer solutions and blends - Criteria for Blend miscibility – Polymer – Polymer Interaction Energies – Hydrogen boding systems – Crystalline polymer blends-Block Copolymers

UNIT- II MELT PROCESSING OF POLYMER BLENDS 9

Factors influencing Morphology – Influence of Processing methods on Morphology Chemistry of compatibilization –Compatibilizers - Reactive compatibilization – Commercially important Blends: Structure – Property relationships

UNIT- III MORPHOLOGY OF POLYMER BLENDS 9

Continuous & discontinuous phases – Microscopic Phase visualization methods – Optical Microscopy, TEM, SEM and AFM – Dispersed phase size and Dispersion Uniformity – Glass transition in Polymers blends and copolymers – Applications of thermal analysis in crystalline polymer blends – Interpenetrating Polymer networks

UNIT- IV PROPERTIES OF POLYMER BLENDS 9

Thermo-mechanical Performance of amorphous – Amorphous and Amorphous- Crystalline blends – Permeability of miscible blends – Barrier materials through control of Blend morphology – Reinforced polymer blend

UNIT- V ELASTOMER BLENDS 9

Miscible and immiscible elastomers blends – Thermoplastic vulcanizates – Thermoset – Thermoplastic Blends – Properties of cured Blends – Rubber Toughening of thermosets – Toughening of semi-crystalline plastics – Recycling of polymer blends.

TOTAL: 45 PERIODS

REFERENCES

1. Paul, D.R. and Bucknall, C.B., “Polymer Blends”, Volumes I and II, Wiley Interscience, 2000.
2. Utracki, L.A., “Polymer Blends Handbook”, Volumes I and II, Kluwer Academic Publishers, 2002.
3. Riew, C.K. and Kinloch, A.J., “Toughened Plastics I – Science and Engineering”, ACS, Advance in Chemistry Series 233, 1993
4. L.H.Sperling, “Introduction to Physical Polymer Science”, Wiley Interscience, 2006

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	1	3	3	3	1	3	1	2	1	2	1	3	2	2	2
CO2	3	2	3	3	3	1	3	1	2	1	2	1	3	2	3	3
CO3	3	2	3	3	3	1	3	1	2	1	2	1	3	2	3	3
Overall CO	**3**	**2**	**3**	**3**	**3**	**1**	**3**	**1**	**2**	**1**	**2**	**1**	**3**	**2**	**3**	**3**

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5017 THEORY OF MACHINES AND MECHANISMS L T P C
3 0 0 3

OBJECTIVES

To make the student to understand the following:

- Various mechanism and its kinematic analysis.
- Various frictional force in mechanical devices.
- Various profile of gear and its mechanisms.
- Balancing in mechanical systems and various vibrations

UNITI MECHANISMS 9

Definition–Machine and Structure–Kinematclink, pairandchain–classificationofKinematicpairs–Constraint&motion–Degreesoffreedom-Slidercrank–singleanddouble–Crankrockermechanisms–Inversions,applications–IntroductiontoKinematicanalysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

UNITII FRICTION 9

Typesoffriction–Frictioninscrewandnut–Screwjack–Pivot,collarandthrustbearings–Plateandconeclutch–belt(flat&V)andropedrives–Creepinbelts–Openand crossedbeltdrives–Ratiooftensions–Effectofcentrifugalandinitialtensions–condition for maximum power transmission.

UNITIII GEARINGAND CAMS 9

Gear–Typesandprofile–Nomenclatureofspur&helicalgears–Lawsofgearing– interference–Requirementofminimumnumberofteethingears–Camsdifferenttypesoffollowers–Cam–Typesofcamsandfollowers–Camdesign for different follower motions.

UNITIV BALANCING 9

Staticanddynamicbalancing–Singleandsevealmassesindifferentplanes–Primaryand secondarybalancingofreciprocatingmasses–Balancingofingleandmulticylinderengines–Governors and Gyroscopic effects.

UNITV VIBRATION 9

Free,forcedanddampedvibrationsofsingledegree offeredomsystems–Forcetransmitted tosupports–VibrationIsolation–Vibrationabsorption–Torsionalvibrationofshafts–Singleand multi rotor systems – Geared shafts – Critical speed of shafts.

TOTAL: 45 PERIODS

OUTCOMES:

- Analyze the practice of forming different mechanism using link
- Be familiar with friction force and its importance in mechanical devices
- Understanding the analysis of gear and cam power transmission
- Scrutinize the effect of unbalance and balancing techniques
- Acquire the knowledge of different vibration and to analyze the transmission of vibration

REFERENCES:

1. Bansal Dr.R.K. “Theory of Machines” Laxmi Publications (P) Ltd., New Delhi 2001
2. Rattan S.S.”Theory of machines”Tata McGraw Hill publishing Co., New Delhi, 2002.
3. RaoJ.S.andDukkipatiR.V.“MechanismandMachineTheory”SecondEdition,Wiley EasternLimited, 1992.
4. MalhotraD.R.andGuptaH.C“TheTheoryofmachines”SatyaPrakasam,Tech.India Publications,1989
5. GoshAandMallickA.K.“TheoryofMachinesandMechanisms”affiliatedeastwest press,1989
6. Shigley J.E. and UickerJ.J.Theory of Machines and Mechanisms” McGraw Hill, 1986.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	3	1	1	2	1	-	-	-	-	1	2	3	-	-	-
CO2	2	3	2	1	2	1	-	-	-	-	2	2	2	1	-	-
CO3	2	3	2	1	3	1	-	-	-	-	2	2	3	2	-	-
CO4	2	2	2	1	2	1	-	-	-	-	2	2	2	1	-	-
CO5	2	3	2	1	2	1	-	-	-	-	2	2	3	2	-	-
Overall CO	2	3	2	1	2	1	-	-	-	-	2	2	3	2	-	-

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

RP5018 POLYMER CHARACTÉRISATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES

To impart knowledge to students in the following:
- Microstructural characterization techniques
- Spectroscopic Characterization
- Rheological Characterization
- Thermal Characterization
- Chromatographic Characterization

UNIT- I CHEMICAL AND MICROSTRUCTURAL CHARACTERIZATION 6

Identification of Olefins, Dienes and other vinyl Polymers by Chemical Methods – preliminary examination – Polymer identification through functional group reactions-Microstructural characterization using X-ray diffraction, SEM, TEM and AFM

UNIT- II SPECTROSCOPIC CHARACTERIZATION OF POLYMERS 12

Vibrational Spectroscopy –Principles - Characterization of Specific functional groups - Group frequencies and Finger Print Regions– Applications in Polymer Blends and alloys - UV – Visible Spectroscopy - Spectrophotometer – Analysis of Cu, Mn, Fe in NR – NMR, Mass Spectroscopy, XPS and their applications in Polymer Characterization

UNIT- III RHEOLOGICAL CHARACTERIZATION 9

Viscosity Characterization – Brookfield Viscosity – Characterization through Dilute solution viscosity – Characterization of Polymer melts – Characterization of Shear and Elongational flow – Rotational and Capillary Rheometers – Rheological Characterization of filled and unfilled Polymers – Rheological Characterization of Rubbers and Thermosets

UNIT- IV THERMAL ANALYSIS 12

Thermal analysis – Instrumentation – Polymer Identification using Thermal Analysis - Compositional analysis – volatile matter, Rubber, Polymer blends, C-black & ash – estimation – Glass transition – Heat capacity – Thermal history of polymers – Degradation – State of cure studies-Characterization of Mechanical & Dielectric Relaxations in Polymers

UNIT- V CHROMATOGRAPHIC CHARACTERIZATION 6

Molecular weight distribution using GPC, HPLC– Biological Separations - Analysis of antioxidant, process oil and additives in Polymer Compounds –Analysis of Decomposition products using GC – Pyrolysis, Gas Chromatography

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Understand basic principles and applications of SEM, TEM, AFM and XRD studies
- Know the importance of spectroscopic techniques in polymer characterization
- Understand the importance of rheological characterization
- Appreciate the importance of thermalstudies in polymer characterization
- Understand basic principles and applications of Pyrolysis GC, HPLC and GPC

REFERENCES:

1. Hummel D.O.and Scholl F., "Atlas of Polymer and Plastics Analysis", Vol.2, Carl Hanser Verlag, 1988
2. Craver, C.D. and Provder T., "Polymer Characterization", ACS Advances in chemistry Series, Volume 227, 1990
3. Vishu Shaw, "Hand Book of Plastics Technology", 2nd Edition, Wiley Interscience, 1998
4. Ottenbrite, Utracki, L.A., and Inoue, "Current Topics in Polymer Science", Vol. I & II, Hanser, 1987.

Course Outcome	Program outcome and Program Specific Outcome															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	3	2	2	1				3	3	3	3	3	3
CO2	3	3	3	3	2	2	1				3	3	3	3	3	3
CO3	3	3	3	3	2	2	1				3	3	3	3	3	3
CO4	3	3	3	3	2	2	1				3	3	3	3	3	3
CO5	3	3	3	3	2	2	1				3	3	3	3	3	3
Overall CO	3	3	3	3	2	2	1				3	3	3	3	3	3

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

AUDIT COURSES (AC)

AD5091 CONSTITUTION OF INDIA L T P C
3 0 0 0

OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I INTRODUCTION 9

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

UNIT II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES 9

Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties

UNIT III ORGANS OF GOVERNANCE 9

Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

UNIT IV EMERGENCY PROVISIONS 9

Emergency Provisions - National Emergency, President Rule, Financial Emergency

UNIT V LOCAL ADMINISTRATION 9

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction-PRI- ZilaPachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block level-Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to understand history and philosophy of Indian Constitution.
CO2: Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3: Able to understand powers and functions of Indian government.
CO4: Able to understand emergency rule.
CO5: Able to understand structure and functions of local administration.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

TEXTBOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

AD5092 **VALUE EDUCATION** **L T P C**
3 0 0 0

OBJECTIVES:

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I INTRODUCTION TO VALUE EDUCATION 9

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements

UNIT II IMPORTANCE OF VALUES 9

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT III INFLUENCE OF VALUE EDUCATION 9

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendshipHappiness Vs suffering, love for truth.

UNIT IV REINCARNATION THROUGH VALUE EDUCATION 9

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation

UNIT V VALUE EDUCATION IN SOCIAL EMPOWERMENT 9

Equality, Non violence, Humility, Role of Women, All religions and same message,Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Gain knowledge of self-development
CO2 – Learn the importance of Human values
CO3 – Develop the overall personality through value education
CO4 – Overcome the self destructive habits with value education
CO5 – Interpret social empowerment with value education

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							✓	✓				✓
CO2							✓	✓	✓			✓
CO3							✓	✓	✓			✓
CO4							✓	✓				✓
CO5							✓	✓				✓

REFERENCES:

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

AD5093 PEDAGOGY STUDIES L T P C
3 0 0 0

OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I INTRODUCTION AND METHODOLOGY: 9

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW 9

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES 9

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT 9

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS 9

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the methodology of pedagogy.
- Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Know the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												✓
CO2												✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES:
1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

AD5094 STRESS MANAGEMENT BY YOGA L T P C
3 0 0 0

OBJECTIVES:
- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I INTRODUCTION TO YOGA 9
Definitions of Eight parts of yog.(Ashtanga)

UNIT II YAM 9
Do`s and Don't's in life.
Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III NIYAM 9
Do`s and Don't's in life.
Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV ASAN 9
Various yog poses and their benefits for mind & body

UNIT V PRANAYAM 9
Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 45 PERIODS

OUTCOMES:
CO1 – Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2 – Learn Do's and Don't's in life through Yam
CO3 – Learn Do's and Don't's in life through Niyam
CO4 – Develop a healthy mind and body through Yog Asans
CO5 – Learn breathing techniques through Pranayam

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							✓	✓				✓
CO2							✓	✓				✓
CO3							✓	✓				✓
CO4							✓	✓				✓
CO5							✓	✓				✓

REFERENCES:
1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

AD5095 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS **L T P C 3 0 0 0**

OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

UNIT I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY – I9

Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II 9

Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT III APPROACH TO DAY TO DAY WORK AND DUTIES 9

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48

UNIT IV STATEMENTS OF BASIC KNOWLEDGE – I 9

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT V PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA9

Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 45PERIODS

OUTCOMES:

CO1: To develop basic personality skills holistically
CO2: To develop deep personality skills holistically to achieve happy goals
CO3: To rewrite the responsibilities
CO4: To reframe a person with stable mind, pleasing personality and determination
CO5: To awaken wisdom in students

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

REFERENCES:

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, AdvaitaAshram,Publication Department, Kolkata,2016

AD5097 ESSENCE OF INDIAN KNOWLEDGE TRADITION L T P C
3 0 0 0

COURSE OBJECTIVES

The course will introduce the students to

- get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I INTRODUCTION TO CULTURE 9

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

UNIT II INDIAN LANGUAGES AND LITERATURE 9

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature

UNIT III RELIGION AND PHILOSOPHY 9

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) 9

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V EDUCATION SYSTEM IN INDIA 9

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

TOTAL: 45PERIODS

COURSE OUTCOMES

After successful completion of the course the students will be able to

- Understand philosophy of Indian culture.
- Distinguish the Indian languages and literature.
- Learn the philosophy of ancient, medieval and modern India.
- Acquire the information about the fine arts in India.
- Know the contribution of scientists of different eras.
- Understand education systems in India

REFERENCES:

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

AD5098 SANGA TAMIL LITERATURE APPRECIATION L T P C
3 0 0 0

Course Objectives: The main learning objective of this course is to make the students an appreciation for:

1. Introduction to Sanga Tamil Literature.
2. 'Agathinai' and'Purathinai' in SangaTamil Literature.
3. 'Attruppadai' in SangaTamil Literature.
4. 'Puranaanuru' in SangaTamil Literature.
5. 'Pathitrupaththu' in SangaTamil Literature.

UNIT I SANGA TAMIL LITERATUREANINTRODUCTION 9

Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil Sangam Literature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's Grammar- Tamil Sangam Literature's parables.

UNIT II 'AGATHINAI'AND'PURATHINAI' 9

Tholkappiyar's Meaningful Verses–Three literature materials–Agathinai's message-History of
Culturefrom Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.

UNIT III 'ATTRUPPADAI'. 9

AttruppadaiLiterature–Attruppadaiin'Puranaanuru'-Attruppadaiin'Pathitrupaththu'-Attruppadai
in 'Paththupaattu'.

UNIT IV 'PURANAANURU'

9

Puranaanuru onGood Administration,Rulerand Subjects–Emotion&itsEffectin Puranaanuru.

UNIT V 'PATHITRUPATHTHU'

9

Pathitrupaththuin'Ettuthogai'–Pathitrupaththu'sParables–
Tamildynasty:Valor,Administration, Charity in Pathitrupaththu- Mesaage to Society from Pathitrupaththu.

Total (L:45) = 45 PERIODS

COURSE OUTCOMES: Upon completionofthiscourse, the studentswillbeableto:

1. Appreciate and apply the messages in Sanga Tamil Literature in their life.
2. Differentiate'Agathinai' and'Purathinai'in their personal andsocietallife.
3. Appreciate and apply the messages in' Attruppadai' in their personal and societalife.
4. Appreciate and apply the messages in' Puranaanuru' in their personal and societallife.
5. Appreciate and apply the messages in' Pathitrupaththu' in their personal and societallife.

REFERENCES:

1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

	P												PS		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1									0.9						0.6
2									0.9						0.6
3									0.9						0.6
4									0.9						0.6
5									0.9						0.6

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

HU5171 LANGUAGE AND COMMUNICATION LT P C
3 0 0 3

COURSE DESCRIPTION

This course offers an introduction to language and communication. The primary goal of this course is to familiarize students with key ideas related to communication using language as well as non verbal means. Ideas related to the use of language and the underlying power structures are also examined. The course also examines the role of media in communication and in the dissemination of ideas as well as opinions.

Objectives

- ✓ To familiarize students with the concept of communication using linguistic and non linguistic resources.
- ✓ To help students ask critical questions regarding facts and opinions.
- ✓ To provide students with the material to discuss issues such as language and power structures.
- ✓ To help students think critically about false propaganda and fake news.

Learning Outcomes

- ➢ Students will be able to use linguistic and non linguistic resources of language in an integrated manner for communication.
- ➢ Students will be able to analyse communication in terms of facts and opinions.
- ➢ Students will be able to discuss, analyse and argue about issues related to language and power.

UNIT I LINGUISTIC AND NON-LINGUISTIC RESOURCE OF COMMUNICATION: 9

a) Writing and Speech
b) Distinction between language structure and language use, form and function, acceptability and grammaticality
c) Gestures and Body language, pictures and symbols, cultural appropriacy
d) Communicative Competency, context and situation, combination of linguistic and non-linguistic elements of communication

UNIT II STRUCTURE OF WRITING/CONVERSATION: 9

a) Language skills and the communication cycle; speaking and listening, writing and reading
b) Initiating and closing conversations, intervention, turn taking
c) Writing for target reader, rhetorical devices and strategies
d) Coherence and Cohesion in speech and writing

UNIT III POWER STRUCTURE AND LANGUAGE USE: 9

a) Gender and language use
b) Politeness expressions and their use
c) Ethical dimensions of language use
d) Language rights as part of human rights

UNIT IV MEDIA COMMUNICATION: 9

a) Print media, electronic media, social media
b) Power of media
c) Manufacturing of opinion, fake news and hidden agendas

UNIT V PERSUASIVE COMMUNICATION AND MISCOMMUNICATION: 9

a) Fundamentals of persuasive communication
b) Persuasive strategies
c) Communication barriers

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Austin, 1962, J.L. How to do things with words. Oxford: Clarendon Press. Grice, P.1989. Studies in the way of words. Cambridge, M.A: Harvard University Press.
2. Chomsky, N.1966. Aspects of the theory of syntax, The MIT press, Cambridge. Chomsky, N.2006. Language and Mind, Cambridge University Press.
3. Hymes. D.N. 1972, On communication competence in J.B. Pride and J.Holmes (ed), Sociolinguistics, pp 269-293, London Penguin.
4. Gilbert, H.Harman, 1976. Psychological aspect of the theory of syntax in Journal of Philosophy, page 75-87.
5. Stephen. C. Levenson, 1983, Pragmatics, Cambridge University press.
6. Stangley, J. 2007. Language in Context. Clarendon press, Oxford. 7. Shannon, 1942. A Mathematical Theory of Communication. 8. Searle, J.R. 1969. Speech acts: An essay in the philosophy of language. Cambridge: Cambridge University Press.

HU5172 **VALUES AND ETHICS** **L T P C**
3 0 0 3

OBJECTIVES:

- Teach definition and classification of values.
- Explain Purusartha.
- Describe Sarvodaya idea.
- Summarize sustenance of life.
- Conclude views of hierarchy of values.

UNIT I DEFINITION AND CLASSIFICATION OF VALUES 9

Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous-Economic-Social-Aesthetic-Moral and Religious values

UNIT II CONCEPTS RELATED TO VALUES 9

Purusartha-Virtue- Right- duty- justice- Equality- Love and Good

UNIT III IDEOLOGY OF SARVODAYA 9

Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

UNIT IV SUSTENANCE OF LIFE 9

The Problem of Sustenance of value in the process of Social, Political and Technological Changes

UNIT V VIEWS ON HIERARCHY OF VALUES 9

The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Able to understand definition and classification of values.
CO2: Able to understand purusartha.
CO3: Able to understand sarvodaya idea.
CO4: Able to understand sustenance of life.
CO5: Able to understand views of hierarchy of values.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1								✓	✓			✓
CO 2								✓	✓			✓
CO 3								✓	✓			✓
CO 4								✓	✓			✓
CO 5								✓	✓			✓

TEXTBOOKS:

1. AwadeshPradhan :MahamanakeVichara. (B.H.U., Vanarasi-2007)
2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)
3. William, K Frankena : Ethics (Prentice Hall of India, 1988)

HU5173 **HUMAN RELATIONS AT WORK** **L T P C**
3 0 0 3

OBJECTIVES:

- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.
- Describe the importance of staying psychologically healthy.
- Identify the essential qualities for progressing in career.

UNIT I UNDERSTANDING AND MANAGING YOURSELF 9

Human Relations and You: Self-Esteem and Self-Confidence: Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

UNIT II DEALING EFFECTIVELY WITH PEOPLE 9

Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

UNIT III STAYING PHYSICALLY HEALTHY 9

Yoga, Pranayam and Exercise: Aerobic and anaerobic.

UNIT IV STAYING PSYCHOLOGICALLY HEALTHY `9

Managing Stress and Personal Problems, Meditation.

UNIT V DEVELOPING CAREER THRUST 9

Getting Ahead in Your Career, Learning Strategies, Perception, Life Span Changes, and Developing Good Work Habits.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

CO1: Understand the importance of self-management.
CO2: Know how to deal with people to develop teamwork.
CO3: Know the importance of staying healthy.
CO4: Know how to manage stress and personal problems.
CO5: Develop the personal qualities essential for career growth.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓		✓	✓			✓
CO2									✓	✓		✓
CO3						✓		✓	✓			✓
CO4								✓				✓
CO5								✓	✓	✓		✓

TEXT BOOK:

1. Dubrien, A. J. (2017). Human Relations for Career and Personal Success: Concepts, Applications, and Skills, 11th Ed. Upper Saddle River, NJ: Pearson.

REFERENCES:

1. Greenberg, J. S. (2017). Comprehensive stress management (14th edition), New York: McGraw Hill.
2. Udai, Y. (2015). Yogasanaurpranayam. New Delhi: N.S. Publications.

HU5174 **PSYCHOLOGICAL PROCESSES** **L T P C**
3 0 0 3

COURSE DESCRIPTION

Psychological Processes course is designed for students to be aware of the basic principles of psychology for the better understanding of people's psyche and behaviour around them. This course enables learners to use the optimal use of different forms of thinking skills and thereby results in effective communication in diverse situations. Every unit of the syllabus highlights the psychological process of people, the most powerful and constructive use of perceptions.

OBJECTIVES

The major objectives of this course is

- To develop students' awareness – on psychology, learning behavior and usage of perception effectively.
- To learn to use the various kinds of thinking in a formal context.
- To critically evaluate content and comprehend the message on the bases of perception, personality and intelligence.

UNIT 1: INTRODUCTION

What is psychology? - Why study psychology? - Psychology as science – Behavior and its role in human communication – socio-cultural bases of behaviour – Biological bases of behavior - Brain and its functions – Principles of Heredity – Cognition and its functions Fields of psychology – Cognitve and Perceptual – Industrial and Organizational.

UNIT 2: SENSORY & PERCEPTUAL PROCESSES

Some general properties of Senses: Visual system – the eye, colour vision – Auditory system – Hearing, listening, Sounds - Other senses - Selective attention; physiological correlates of attention; Internal influences on perception learning – set - motivation & emotion - cognitive styles; External influences on perception figure and ground separation – movement – organization – illusion; Internal- external interactions: Constancy - Depth Perception- Binocular & Monocular Perception; Perceptual defense & Perceptual vigilance; Sensory deprivation -Sensory bombardment; ESP - Social Perception.

UNIT 3: COGNITION & AFFECT

Learning and memory – philosophy of mind – concepts - words – images – semantic features – Association of words – Repetition – Retrieval – Chunking - Schemata - Emotion and motivation – nature and types of motivation – Biological & Psychosocial motivation – nature and types of emotions – physiological & cognitive bases of emotions – expressions of emotions – managing negative emotions - enhancing positive emotions.

UNIT 4: THINKING, PROBLEM-SOLVING & DECISION MAKING

Thinking skills – Types of thinking skills – Concrete & Abstract thinking – Convergent & Divergent - Analytical & Creative thinking – Problem & Possibility thinking – Vertical & Lateral thinking – Problem solving skills – stages of problem solving skills – Decision making - intuition and reasoning skills - Thinking and language - The thinking process- concepts, problem solving, decision-making, creative thinking; language communication.

UNIT 5: PERSONALITY & INTELLIGENCE

Psychological phenomena & Attributes of humans - cognition, motivation, and behavior - thoughts, feelings, perceptions, and actions – personality dimensions, traits, patterns - Specialized knowledge, performance accomplishments, automaticity or ease of functioning, skilled performance under challenge - generative flexibility, and speed of learning or behavior change.

References

1. Morgan, C.T.and King, R.A (1994) Introduction to Psychology, Tata McGraw Hill Co Ltd, New Delhi.
2. Robert A. Baron (2002), Psychology, 5th Edition, Prentice Hall, India.
3. Michael W.Passer, Ronald E.smith (2007), Psychology: The science of mind and Behavior,3rd Edition Tata McGraw-Hill Edition.
4. Robert S.Feldman (2004) Understanding Psychology 6th Edition Tata McGraw – Hill.
5. Endler, N. S., & Summerfeldt, L. J. (1995). Intelligence. personality. psychopathology. and adjustment. In D. H. Saklofske & M. Zeidner (Eds.). International handbook of personality and intelligence (pp. 249-284). New York: Plenum Press.

6 Ford, M. E. (1994). A living systems approach to the integration of personality and intelligence. In R. J. Sternberg. & P. Ruzgis (Eds.). Personality and intelligence (pp. 188-21 7). New York: Cambridge University Press.

De Bono, E (1990) Lateral Thinking, Harper Perennial, New York.

HU5175 EDUCATION, TECHNOLOGY AND SOCIETY L T P C
3 0 0 3

COURSE DESCRIPTION

This course introduces students to multidisciplinary studies in Education, Technology and Society. Students will get an understanding of the relationship between education, technology and society. They will also learn about the long lasting impact of good education in a technologically advanced society.

COURSE OBJECTIVES:

The course aims

- To help learners understand the basics of different types of technology utilised in the field of education
- To make them realize the impact of education in society
- To make them evolve as responsible citizen in a technologically advanced society

LEARNING OUTCOMES

By the end of the course, learners will be able to

- Understand the various apps of technology apps and use them to access, generate and present information effectively.
- Apply technology based resources and other media formats equitably, ethically and legally.
- Integrate their technical education for betterment of society as well as their personal life.

UNIT I INDIAN EDUCATION SYSTEM

Gurukul to ICT education – Teacher as facilitator – Macaulay's Minutes – English medium vs Regional medium – Importance of Education in Modern India - Challenges in Education

UNIT II LEARNING THEORIES

Learning Theories – Behaviorism – Cognitivism – Social Constuctivism – Humanism Learning Styles – Multiple Intelligences – Emotional Intelligence – Blooms Taxonomy

UNIT III TECHNOLOGICAL ADVANCEMENTS

Web tools – Social media in education – elearning – MOOCs – Mobile assisted learning – Learning Apps – Blended learning - Self-directed learning

UNIT IV EDUCATIONAL TECHNOLOGY

Technological implications on Education – Teaching, Learning & Testing with Technology - Advantages and drawbacks – Critical analysis on the use of technology

UNIT V ETHICAL IMPLICATIONS

Plagiarism – Online Copyright issues – Ethical and value implications of education and technology on individual and society.

TOTAL:45 PERIODS

TEACHING METHODS

Teaching modes include guest lectures, discussion groups, presentations, visual media, and a practicum style of learning.

EVALUATION

As this is course is not a content based course, it focuses more on the ethical use of technology in education and society, and so, evaluation can be based on assignments and discussions. So there is no need for an end semester examination. Internals marks can be taken for the total marks.

INTERNAL (100 % WEIGHTAGE)

(a) Written Test (40 marks)

(b) Assignment: Write a real time report of the technology use in any school / college (15 marks)

(c) Presentation: Students choose any one of the technological tools and present its relevance to education and society (15 marks)

(d) Group discussion: Students discuss in groups on case studies relating to various challenges in education and technology use in society (20 marks)

(e) Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

REFERENCES

1) Education and Social order by Bertrand Russel
2) Theories of learning by Bower and Hilgard
3) Technology and Society by Jan L Harrington

HU5176 PHILOSOPHY L T P C
3 0 0 3

OBJECTIVES

- To create a new understanding by teaching philosophy through a comparison of Indian and Western traditions.
- To Fosters critical thinking and imagination by dealing with inter-related concepts in literature and science.
- To bridge the gap between the sciences and humanities through introspective analyses.
- To nurture an understanding of the self and elucidates ways to progress towards a higher understanding of one's self and others.

UNIT I KNOWLEDGE 9

Knowledge (Vidya) Versus Ignorance (Avidya)- Brihadaranyaka Upanishad. Unity and Multiplicity – Isha Upanishad. What is True Knowledge? Ways to True Knowledge. Introduction to Philosophy of Yoga, Socratic Debate, Plato's Views. Asking and Answering Questions to Stimulate Critical Thinking and to Draw Ideas. Argumentative Dialogues. Dialectical Methods to Arrive at Conclusions.

UNIT II ORIGIN 9

Origin of Universe And Creation – 'Nasidiya Sukta' in Relation With Big Bang Theory. Greek Concept of Chaos. The Concept of Space – Space as the Final Goal – Udgitha. Relationship Between Teacher And Student – The Knowledge Of Combinations, Body And Speech – Siksha Valli – Taittriya Upanishad.

UNIT III WORD 9

Aum- Speech and Breath as Pair – Chandogya Upanishad and Brihadaryanaka Upanishad. Significance of Chants, Structure of Language and Cosmic Correspondences. The Non-Dual Word – Bhartrihari's Vakyapadiyam. Sphota-Ultimate Reality Expressed Through Language. Intention. Thought 'Sabdanaor' and Speaking.

UNIT IV KNOWLEDGE AS POWER/OPPRESSION 9

Power- as Self-Realization in Gita. Krishna's Advice to Arjuna on How to Conquer Mind. Francis Bacon – Four Idols – What Prevents One From Gaining Knowledge? Michel Foucault- Knowledge as Oppression. Panopticon. Rtam (Truth) and Satyam (Eternal Truth).

UNIT V SELF KNOWLEDGE/BRAHMAN 9

Knowledge about Self, Transcendental Self. The Different Chakras and the Stages of Sublimation. Philosophy of Yoga and Siva for Union of Mind and Body. Concept of Yin/Yang. Aspects of the Feminine / Masculine.

TOTAL : 45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Think sceptically, ask questions and to arrive at deductions.
2. Connect and relate different branches of thought.
3. Comprehends the relation between language, thought and action.
4. Arrive at a better understanding of self and others and forms a new outlook.

REFERENCES:

1. Swami Nikhilananda: The Upanishads, Swami Nikhilananda, Advaita Ashrama, Kolkata.
2. Swamy Tapasyananda: Srimad Bhagavad Gita, The Scripture of Mankind, Sri Ramakrishna Math, Chennai.
3. Subrahmanyam, Korada: Vakyapadiyam of Bhartrhari Brahmakanda, Sri Garib Dass series.
4. Swami Lokeswarananda: Chandogya Upanishad, Swami Lokeswarananda, Ramakrishna Mission Institute of Culture, Kolkata.
5. Brahma, Apuruseya: The Four Vedas: Translated in English.
6. Haich, Elizabeth: Sexual Energy and Yoga.
7. Bacon, Francis: Power as Knowledge
8. Vlastos, Gregory: Socrates Ironist and Moral Philosopher.
9. Plato: The Republic, Penguin.
10. Gutting, Garry: Foucault A Very Short Introduction, Oxford.

HU5177 APPLICATIONS OF PSYCHOLOGY IN EVERYDAY LIFE L T P C
3 0 0 3

UNIT I INTRODUCTION 7
Natureandfields.

UNIT II PSYCHOLOGYININDUSTRIESAND ORGANIZATIONS 9
Jobanalysis; fatigueandaccidents;consumerbehavior.

UNIT III PSYCHOLOGY AND MENTALHEALTH 11
Abnormality,symptomsandcausespsychological disorders

UNIT IV PSYCHOLOGY AND COUNSELING 7
NeedofCounseling, CounselorandtheCounselee,CounselingProcess,Areasof Counseling.

UNIT V PSYCHOLOGY AND SOCIALBEHAVIOUR 11
Group, groupdynamics, teambuilding,Prejudiceandstereotypes; EffectiveCommunication, conflictandnegotiation.

TOTAL:45PERIODS

TEXTBOOKS

1. Schultz,D.&Schultz,S.E.(2009). PsychologyandWorkToday(10thed.). New Jersey:Pearson/PrenticeHall
2. Butcher,J.N., Mineka,S.,&Hooley,J. M.(2010). Abnormal psychology(14th ed.).NewYork: Pearson
3. Gladding,S.T. (2014).Counselling:Acomprehensiveprofession. NewDelhi: PearsonEducation
4. Aronson, E.,Wilson, T. D.,&Akert, R. M.(2010).Social Psychology(7th Ed.).UpperSaddleRiver,NJ: PrenticeHall